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PHYSICS ABSTRACTS

SEPTEMBER 1956

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Physics Abstracts

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Lines and networks
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PHYSICS ABSTRACTS

olume 59 SEPTEMBER 1956 Number 705

MATHEMATICS

518.2

6285. TABLES OF THE FUNCTION ARC SIN Z. London: Oxford University Press; Cambridge, Mass.: Harvard University Press (1956) 624 pp.

518.43 : 518.5

6286. NEW COMPUTER METHOD FOR OBTAINING OPTIMUM AREA. J.F.Tyroler and C.L.Smith. Rev. sci. Instrum., Vol. 27, No. 6, 392-4 (June, 1956).

An automatic computer method for obtaining the optimum area for any fixed time interval under a transient is described and discussed. This method automatically chooses the point on the transient where integration of the area is initiated and a preset timer stops the integrator after the selected time interval has elapsed. This method is based on the use of a magnetic tape recorder with a modified playback arrangement and integrator. The initiating point is choosen with an accuracy of ± 0.028 V where the input signal range is zero to ten volts. The stability of the one-shot timing circuit is one part in a thousand with a gate time between 40 and 500 milliseconds. The system accuracy for obtaining area depends on the particular magnetic tape system and integrator used, and type of transient being examined. A.

518.5

6287. THE ISOGRAPH—AN ELECTRONIC ROOT FINDER. A.K.Choudhury. Indian J. Phys., Vol. 29, No. 10, 468-73 (Oct., 1955).

Describes an electronic isograph for finding the roots of high-degree polynomials. The harmonic generator used is a purely electronic device without any moving parts. The different harmonic components are generated with the help of a delay line, fed from a matched frequency-sweep generator. By controlling the amount of frequency sweep of the oscillator any desired interval of the argument can be expanded, thus enabling accurate determination of the argument of the root. A.

518.5

6288. ANALOG COMPUTER FOR THE DIFFERENTIAL EQUATION $y'' + f(x)y + g(x) = 0$. E.Bodenstedt. Rev. sci. Instrum., Vol. 27, No. 4, 218-21 (April, 1956).

A high-precision electromechanical analogue computer is described. The mechanical system is a torsion pendulum. Programmed torques provide an equation of motion which is identical to the equation: $y'' + f(x)y + g(x) = 0$. The solutions are obtained by recording the motion by means of a recording camera. The analogue computer is used to study the betatron oscillations and the effects of resonances for the strong-focusing Cornell synchrotron. A.

519.2 : 530.162

6289. ON THE USE OF GRAM-CHARLIER SERIES TO REPRESENT NOISE. C.W.Horton. J. appl. Phys., Vol. 27, No. 4, 350-6 (April, 1956).

The stochastic time series produced by the arrival at random times of identical individual events is considered. It is shown that if the shape of the individual events and of the resulting autocorrelation function and power spectrum are each represented by a Gram-Charlier series, relatively simple relationships exist between the different sequences of coefficients. These relationships are most serviceable when the coefficients of the autocorrelation function are used as the primary quantities. If the band width of the noise is "moderate", the series has a small number of terms and consequently is practical from a computational viewpoint. The formula are applied to the experimental data of noise produced when current is forced backwards through a silicon crystal. The shape of the individual noise events is determined from a knowledge of the experimental autocorrelation function. As a check on the analysis the power spectrum and the expected number of zeros per second are computed from the Gram-Charlier series and compared with the experimental data. A.

519.2

6290. STATISTICAL DISTRIBUTIONS WITH BOUNDED COMPONENTS. W.Fucks. Z. Phys., Vol. 145, No. 4, 520-33 (1956). In German.

A contribution to the statistical problems arising in the mathematical theory of word formation. A type of frequency distribution is studied which is a weighted sum of a number of distributions, the weights being $a_1, \ldots, a_n$. Graphs are given showing the theoretical frequency distributions for various values of the a-sequence, and for various values of the mean value. A method is described for finding the a-sequence from an empirically given distribution. L.S.Goddard

519.241.1 : 518.5

6291. A TECHNIQUE FOR APPROXIMATE MEASUREMENT OF CORRELATION COEFFICIENTS. T.P.Goodman. J. appl. Phys., Vol. 27, No. 7, 773-5 (June, 1956).

A new method is described for approximate measurement of the coefficient of correlation between two random variables which can be represented by time-varying electrical voltages. This method makes use of simple analogue-computing elements to obtain the coefficient of linear regression of one variable on the other. Its use in connection with an oscilloscope display of the two variables is described, and the relation between these displays and the Lissajous figure formed by two sinusoids is discussed. A possible design for a direct-reading correlation meter is suggested. A.

519.3 : 539.152.1

6292. EXTENSIONS OF VARIATIONAL METHODS. I. SUPER-STATIONARY VARIATIONAL METHOD. T.Kikuta. Progr. theor. Phys., Vol. 14, No. 5, 457-72 (Nov., 1955).

Several methods to improve the degree of approximation for the stationary character in variational methods are discussed. By selecting a set of trial functions as prescribed in the present paper, it is shown that one can construct quite generally a super-stationary expression for the quantity to be found. By "super-stationary" it is meant that, the first, second and third variations of that expression vanish for any infinitesimal variations of trial functions. The examples to which this method is applied are: (1). To find the eigenvalue in the eigenvalue-problems with discrete spectra only (for example, to find the potential depth in the deuteron problem). (II). To find the discrete eigenvalues for the problems with both discrete and continuous spectra (for example, to find the energy level of the deuteron). (III). To solve problems for

continuous spectra by integral equations. (IV). To solve problems for continuous spectra by differential equations. Also a method is mentioned for improving the approximation to the stationary character in successive manner in each case and is shown that a simple method for this improvement exists in the cases (I) and (II). A

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.21

6293. A NEW TYPE OF TELESCOPE MIRROR.
G.Horn-D'Arturo.
Optik, Vol. 13, No. 6, 254-8 (1956). In German.

A large astronomical telescope objective is made from 61 separate small mirrors, each of which is spherical and mounted on a three-point support for adjustment. Many practical details are given of the manufacture, mounting and tolerances applicable to these mirrors. R.W.Fish

522.56

6294. BALLOON-BORNE SYSTEM FOR TRACKING THE SUN. H.D.Edwards, A.Goddard, Jr, M.Juza, T.Maher and F.Speck.
Rev. sci. Instrum., Vol. 27, No. 6, 381-5 (June, 1956).

A balloon-borne system for tracking the sun both in elevation and azimuth is described. The system weighs approximately 125 lb and is capable of "pointing" as much as 20 lb of payload at a predetermined position in the sky. Power requirements are 20 W. An accuracy in pointing of ± 15 min of arc has been achieved. At some sacrifice in simplicity, this accuracy could perhaps be improved to ± 5 min. Results of two flights, each attaining an altitude in excess of 100 000 ft, are given. A.

523.03 : 539.165.2

6295. BETA-PROCESSES AND ASTROPHYSICS.
D.A.Frank-Kamenetskiĭ.
Uspekhi fiz. Nauk, Vol. 58, No. 3, 415-32 (1956). In Russian.

Use of the theory of β-decay for prediction of the properties of real stars, and conclusions concerning the constant of β-interaction from astrophysical data. Topics discussed: the proton reaction and possible variants, stellar composition diagrams (mass—luminosity, mass—radius, Hertzsprung—Russell), determination of the constant of a β-process from the properties of the sun, triplet β-interaction, central density and structure of a star, the Naur model. 34 refs.
C.R.S.Manders

523.12 : 530.162

6296. FURTHER DISCUSSION ON FLUCTUATIONS IN GRAVITATING SYSTEMS. Ya. P. Terletskiĭ.
Zh. éksper. teor. Fiz., Vol. 29, No. 2 (8), 237-41 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 262-5 (March, 1956).

Answer to the criticism (Abstr. 6686/1955) of author's work (Abstr. 7878/1952).

523.164

6297. STRIP INTEGRATION IN RADIO ASTRONOMY.
R.N.Bracewell.
Austral. J. Phys., Vol. 9, No. 2, 198-217 (June, 1956).

When a celestial source of radio waves is scanned with an aerial beam which is much longer than the source in one direction but suitably narrow in the other, the transformation from the true distribution to the measured value is referred to as strip integration. It is here treated as a special case of two-dimensional aerial smoothing in which the aerial beam is allowed to spin about its centre as it moves about the sky. It is shown that the resolution obtainable is set by the cross-sectional profile of the strip beam in the narrow dimension. Thus, when the strip reduces to a line, the resolution is complete and full reconstruction of the true distribution is possible; but scans must be made in all directions. In the general case it is shown that there is a principal solution, and that a finite number of scans suffices to determine it. A method is presented for reconstructing the principal solution from the observed data. A

523.164.

6298. 18.3 Mc/s RADIATION FROM JUPITER. C.A.Shain
Austral. J. Phys., Vol. 9, No. 1, 61-73 (March, 1956).

Burke and Franklin's discovery of radio emission from Jupiter has been confirmed. Examination of old records has shown that in 1950-51 the radiation came in groups of bursts of very high intensity. Bursts have durations of the order of minute or less; groups, of an hour. Because of the remarkably close relation between active periods and the period of rotation of Jupiter, it is inferred that the source at the time was very localized. Its identification with a visual disturbanc in the South Temperate Belt is very probable. It is pointed out that occulation by Jupiter's satellites may help to locate the sources of radiation, both in position and in height relativ to the visible surface, and that Jupiter radiation should be a valuable tool for studying the outer regions of the solar corona. A

523.164.32 : 523.75

6299. RADIO INVESTIGATIONS OF THE STRUCTURE OF THE SOLAR CORONA. M.Ryle.
Solar eclipses and the ionosphere (London) 246-52. See Abstr 4116 (1956) and following abstracts.

Observations of the solar emission at metre wavelengths may be used to derive information on the distribution of electron density and temperature in the undisturbed solar corona. It is, however, necessary to determine at each of several wavelengths the distribution of "radio brightness" across the solar disk, which is not the case with the corresponding centi metre wave observations. These measurements have been ma by observations of the variation of intensity during an eclipse, and more extensively by using interferometric methods to provide a sufficiently high resolving power. Using the results of such observations preliminary models of the solar corona have been derived. An entirely different method of observatio has been used to study the outermost layers of the solar envelope. In this method, observations are made of a radio star at different angular distances from the sun. The results show that as this angle decreases the apparent angular size of the radio star increases, due to scattering by irregularities i the electron density. It has been possible to detect this effect out to distances of 20 $R_\odot$, and important deductions about the electron density in this region can be made. A.

523.164.32 : 523.78

6300. RADIAL BRIGHTNESS DISTRIBUTION OF THE SUN AT 8 mm. J.P.Hagen.
Solar eclipses and the ionosphere (London) 253-7 (1956).

The principal solar radiation in the centimetre and millimetre regions comes from the chromosphere, and measurements of the variation in flux at these wavelengths during the course of an eclipse may be used to give a model of the solar atmosphere. Measurements of distribution of radio brightnes at 8 mm made in Sweden during the 1954 eclipse show limb-brightening and a marked amount of brightness at the centre of the disk, which may be explained in terms of a two-fluid theory of the chromosphere: cool, dense spicules extending into a hotter, sparser gas of the lower corona. G.M.Brow

523.164.32 : 551.521.67

6301. SOLAR RADIO NOISE AND THE STUDY OF CORPUSULAR STREAMS FROM THE SUN. J.P.Wild.
olar eclipses and the ionosphere (London) 258-60 (1956).

Observations in Australia over several years with a ynamic spectroscope covering the frequency range 40-240 Mc/s ave shown that most sporadic bursts of radio emission from he sun fall into two distinct spectral classes, having quite iscrete ranges of outward radial velocity. Both types of radio urst may occur at the time of solar flares. It is thought that he slower velocities may be associated with the outrush from he sun of geomagnetic storm particles, while the very fast ange of velocities may be associated with the ejection from the un of the agency responsible for the increase in cosmic rays ometimes observed about one hour after flares. G.M.Brown

523.164.32 : 523.78

6302. RADIO OBSERVATIONS OF THE ECLIPSE OF 30 JUNE 1954. M.Laffineur, P.Coupiac and B.Vauquois.
Solar eclipses and the ionosphere (London) 261-3 (1956).
In French.

The authors have observed the eclipse with the aid of the radio telescope already used by one of them in 1952 at Khartoum. The curve of the eclipse appears very regular, more so than in 1952, while the emission at the instant of optical totality is less intense than in 1952 (14.7% against 19.5% on 545 Mc/s). G.M.Brown

523.164.32 : 523.745 : 523.78

6303. A MODEL FOR THE SOLAR ENHANCED REGION AT CENTIMETRE RANGE DERIVED FROM PARTIAL ECLIPSE OBSERVATIONS. T.Hatanaka, K.Akabane, F.Moriyama, H.Tanaka and T.Kakinuma.
Solar eclipses and the ionosphere (London) 264-71 (1956).

The partial eclipse of the sun on 20 June, 1955 was observed at three stations in Japan (Kagoshima, Toyokawa and Tokyo) at frequencies ranging from 3000 Mc/s to 4000 Mc/s. At Kagoshima and Toyokawa the moon covered a large sunspot-group in the southerm hemisphere, and a considerable decrease in flux was observed, while at Mitaka the flux decreased by only a few %. Interferometric observations at Toyokawa isolated the flux variation of the enhanced region. By combining the observed curves, the location, size, and brightness distribution of the enhanced region were derived. The observed size of the region is approximately 4'. The brightness temperature is of the order of 10^6 degrees, but is not uniform over the region. Limb-brightening only at the equatorial zone is also suggested. G.M.Brown

523.164.32 : 523.78

6304. ECLIPSE OBSERVATIONS OF SOLAR RADIO FREQUENCY RADIATION ON 200, 545, 3000 AND 9100 Mc/s. A.D.Fokker, J.C.de Munck and L.D.de Feiter.
Solar eclipses and the ionosphere (London) 272-4. See Abstr. 4116 (1956) and preceding abstracts.

A brief summary is presented of solar radio-noise observations on four frequencies during the eclipse of 30 June, 1954. In the case of the frequencies 545 and 200 Mc/s, the duration of the radio eclipse exceeded that of the optical eclipse by about 10 and 13 min. respectively. For the higher frequencies the durations of the radio and optical eclipses are approximately equal. In most cases, maximum phase of the radio eclipse occurred some minutes later than that of the visual eclipse. G.M.Brown

523.164.4

6305. THE HALO DISTRIBUTION OF RADIO EMISSION AND EXTENDED MAGNETIC FIELDS IN OUR GALAXY AND M 31. G.R.Burbidge.
Astrophys. J., Vol. 123, No. 1, 178-81 (Jan., 1956).

The spherically-symmetrical component of radio radiation in the Galaxy and in M 31 is supposed due to synchrotron radiation of electrons with relativistic energies. This hypothesis is examined by making the assumptions (i) that each galaxy is surrounded by a spherical distribution of diffuse gas, (ii) that there is a spherical distribution of magnetic field in equilibrium with the gas, and (iii) that a flux of high-energy electrons circulates through this volume. The electrons are supposed to have a cosmic-ray type energy distribution. Magnetic fields $\sim 10^{-6}$ gauss are required. The origin of the high-energy electrons, and the mechanism by which they gain energy as well as lose it by radiation are discussed.
M.W.Ovenden

523.164.4

6306. A MODEL FOR NONTHERMAL RADIO-SOURCE SPECTRA. N.G.Roman and F.T.Haddock.
Astrophys. J., Vol. 124, No. 1, 35-42 (July, 1956).

A model is presented to explain the observed radio spectrum of Cassiopeia A on the assumption that the underlying nonthermal emission process has an intrinsic spectrum which follows the law, $S(\nu) \propto \nu^{-a}$. With only minor adjustments, the same model can explain several rather different source spectra. A.

523.164.4 : 621.396.9 : 621.396.62

6307. A RECEIVER FOR THE RADIO WAVES FROM INTERSTELLAR HYDROGEN. I. THE INVESTIGATION OF THE HYDROGEN RADIATION. C.A.Muller.
Philips tech. Rev., Vol. 17, No. 11, 305-15 (May, 1956).

A brief account is given of the structure of the Galactic System and the role played by interstellar hydrogen as source of radio waves of sharply defined frequency; this is followed by a short description of the principles of operation of a receiver used to detect these waves and measure their intensity, set up at Kootwijk (and now removed to Dwingelo) by the Netherlands Foundation for Radio Astronomy. The hydrogen radiation from space is picked up by a dipole aerial in the focus of a parabolic reflector 7.5 m in diameter. The radiation has the character of noise and is very weak, many times weaker than the noise level in the receiver itself; this necessitates special methods of measurement in order to achieve a reasonable accuracy. If the received noise power is expressed as a temperature defined by means of the Rayleigh-Jeans law, the maximum received intensity corresponds to a temperature of about 110°K. The accuracy of measurement reached is 1°K, i.e. 0.1% of the receiver noise. A.

523.164.4 : 621.396.9 : 621.396.62

6308. A RECEIVER FOR THE RADIO WAVES FROM INTERSTELLAR HYDROGEN. II. DESIGN OF THE RECEIVER. C.A.Muller.
Philips tech. Rev., Vol. 17, No. 12, 351-61 (June, 1956).

523.164.42

6309. COSMIC RADIO SOURCES OBSERVED AT 600 Mc/s. J.H.Piddington and G.H.Trent.
Austral. J. Phys., Vol. 9, No. 1, 74-83 (March, 1956).

A survey of cosmic radio emission at 600 Mc/s using a beam $3^\circ.3$ wide has been made over most of the celestial sphere between declinations 90°S. and 51°N. Discrete sources numbering 49 were located having flux densities of about 1×10^{-24} W.m^{-2}.(c/s)$^{-1}$ or more. Of these, 18 do not appear to have been reported previously, including 12 which lie within $\pm 2^\circ$ of the galactic plane. Most of the sources seem to be associated with other sources or with irregularities of the background radiation. There seems to be no sharp boundary between discrete sources and such irregularities. Many of the new sources are likely to be clouds of thermally emitting H II. A.

523.164.42

6310. RADIO EMISSION FROM NOVAE AND SUPERNOVAE. B.Y.Mills, A.G.Little and K.V.Sheridan.
Austral. J. Phys., Vol. 9, No. 1, 84-9 (March, 1956).

Attempts have been made to observe the radio emission at 3.5 m from two supernovae and ten novae. Kepler's star was the only reasonably certain identification. A comparison

with radio observations of other supernovae remnants suggests a constant ratio between the present radio emission and the maximum emission of light. It is concluded that for common novae, which are not detectable as radio sources, this ratio must be smaller than for supernovae. The galactic radio emission near the plane of the Milky Way could be largely the integrated emission of supernova remnants but common novae could not contribute appreciably. A.

523.164.42 : 523.852.3

6311. THE MASSES OF THE MAGELLANIC CLOUDS FROM RADIO OBSERVATIONS. F.J.Kerr and F.de Vaucouleurs.
Austral. J. Phys., Vol. 9, No. 1, 90-111 (March, 1956).

The problem of deriving the masses of the Magellanic Clouds is discussed, and provisional estimates are obtained from 21 cm measurements of the distribution of radial velocity. Various lower and upper limits to the mass of the Large Cloud are found, varying from 1.4×10^9 to 4.4×10^9 solar masses. The best estimate on present evidence is 3.0×10^9. Apart from theoretical considerations, the major uncertainty arises from the sensitivity of the mass to the tilt angle, which is here taken as 65°; the actual value may be somewhat higher and the mass estimate accordingly larger. A provisional value for the mass of the Small Cloud, which can only be estimated by analogy with the Large Cloud, is 1.3×10^9. With these masses the observed differential velocity indicates that the Clouds probably do not describe a closed orbit around each other. The mass-luminosity ratio appears to be somewhat lower than corresponding values for other galaxies, supporting the view that the Clouds are young systems. A.

523.164.42

6312. EMISSION NEBULAE AS RADIO SOURCES.
B.Y.Mills, A.G.Little and K.V.Sheridan.
Austral. J. Phys., Vol. 9, No. 2, 218-27 (June, 1956).

Attempts have been made to detect 14 bright emission nebulae at a wavelength of 3.5 m using a pencil-beam radio telescope with a beamwidth of 50 min of arc. Of these nebulae, six were probably observed in emission, seven were undetectable, and one, NGC 6357, was observed in absorption; radio isophotes were obtained for NGC 2237 and NGC 3372. Radio and optical data have been combined to estimate electron densities, masses, and sometimes the electron temperature of many of the nebulae. Values range from an electron density of 3 cm^{-3} and a mass of 3×10^6 solar masses for the outer regions of the 30 Doradus complex to an average electron density of 500 cm^{-3} and a mass of 20 solar masses for the Orion Nebula. Temperatures generally appear to be in the neighbourhood of 10 000°K, except in the case of NGC 6357, for which 6500°K is estimated. A.

523.164.85

6313. METEORIC ECHOES OBSERVED SIMULTANEOUSLY BY BACK SCATTER AND FORWARD SCATTER.
D.W.R.McKinley and A.G.McNamara.
Canad. J. Phys., Vol. 34, No. 7, 625-37 (July, 1956).

Simultaneous observations of back-scatter and forward-scatter meteoric echoes have been made by means of a high-power 33 Mc/s pulse transmitter at Ottawa, with identical receiving systems at Ottawa and at Scarboro, 337.8 km distant. Two-way transmissions, employing a low-power transmitter at Scarboro, were also used to measure absolute time delays. The approximate position of each meteor was plotted from the observed time delays, which enabled corrections to be applied to the echo durations for variations in aerial patterns and other factors, and which also determined the forward-scatter angle, 2ϕ, for each meteor. In the majority of cases an enhancement was observed in the forward-scatter duration relative to the back-scatter duration. The data were divided into a short-duration of underdense group and a long-duration or overdense group. Assuming a theoretical forward-scatter enhancement proportional to $\sec^m \phi$, it was found that the exponent, m, was 1.73 for the underdense group and 1.13 for the overdense group. A.

523.

6314. METEOR IONIZATION AND ITS DEPENDENCE ON VELOCITY. G.S.Hawkins.
Astrophys. J., Vol. 124, No. 1, 311-13 (July, 1956).

The ionizing efficiency of evaporated meteor atoms is found to be strongly dependent on the velocity of the meteor. A

523.72

6315. THE X-RAY RADIATION OF THE SOLAR CORONA AND HOT CORONAL CONDENSATIONS. G.Elwert.
Solar eclipses and the ionosphere (London) 167-73. See Abstr. 4116 (1956).

In former papers of the author, the soft X-ray radiation of the undisturbed sun was calculated and its effect on the atmosphere of the earth was discussed. It was shown that this radiation could explain the formation of the normal E-layer. The calculated height and thickness as well as the electron density in the case of equilibrium between ionization and recombination are in accord with the observed data. This theor has been extended by calculations of the thermal radiation of coronal condensations, which are generally believed to be the origin of the slowly varying component of the radio emission the sun. The radiation of the condensations was calculated as suming electron densities as derived by Waldmeier and Mülle and temperatures of several million degrees as postulated by Waldmeier, Piddington, and Minnett. We find a remarkable increase of the X-ray radiation below about 20 A and a short-wavelength limit in the neighbourhood of 7 A. These results are in agreement with observations of the X-ray radiation by rocket exploration. A

523.72 : 537.591.

INCREASE OF COSMIC RAY INTENSITY ASSOCIATED WITH THE SOLAR FLARE OF FEBRUARY 23, 1956. See Abstr. 5992

523.75

6316. THE ASPECT OF THE CORONA IN FRONT OF THE SUN'S DISK. M.Waldmeier.
Solar eclipses and the ionosphere (London) 164-6. See Abstr. 4116 (1956).

Although a qualitatively correct picture of the corona ove a given point of the solar disk, not on the limb, can be obtaine by interpolation from the observed intensity over the point wh it was on the limb, this method neglects the varying depth of coronal material penetrated along different lines of sight. Th monochromatic corona thus determined will show pronounced limb brightening. G.M.Brown

523.755 : 523.72

6317. THE STATISTICS OF CORONAL RADIATION.
R.Müller.
Z. Astrophys., Vol. 38, No. 3, 212-16 (1955). In German.

Observations of the coronal emission line at 5303 A over the period 1943-1955, when plotted to exhibit heliographic latitude distribution versus epoch of observation, reveal two principal zones of enhanced activity which appear in lat. ±55 degrees about one year before sunspot minimum, thereafter drifting equator-ward to reach lat. ±20 degrees at sunspot maximum, and ±15 degrees just previous to the commencement of a new cycle. At the same time, a secondary zone of activity moves from lat. ±55 degrees into higher latitudes, reaching the poles at sunspot maximum. D.R.Barber

523.77

6318. THE DISTRIBUTION OF Ly-α RADIATION OVER THE SOLAR DISK. C.de Jager.
Solar eclipses and the ionosphere (London) 174-9. See Abstr. 4116 (1956).

The minimum intensity of the Ly-α line, measured with the rocket technique, yields a radiation temperature of 6800° for the centre of the line. The corresponding electron tempera

are of the chromosphere is 66 000° ± 10 000°; this temperature prevails in the layers about 9500 km above the photosphere. The variation of intensity of the Ly-α line over the disk is computed and compared with the observations. A qualitative discussion of the enhanced Ly-α radiation in plages and flares is given. A.

523.77

6319. PRELIMINARY RESULTS WITH A VACUUM SOLAR SPECTROGRAPH. R.R.McMath, O.C.Mohler, A.K.Pierce and L.Goldberg.
Astrophys. J., Vol. 124, No. 1, 1-12 (July, 1956).

New observations of the solar spectrum with a high-resolution vacuum spectrograph reveal a wealth of detail in the cores of all Fraunhofer lines observed both in the normal disk and in areas exhibiting various kinds of solar activity. The lines show fluctuations in width, intensity, and position over intervals as small as 2 seconds of arc. A representative collection of photographs is presented, together with tentative conclusions derived from inspection and preliminary measurement. Measurements of Doppler shifts have been carried out in considerable detail for the two lines Cr λ 4626 and Ba^+ λ 5853. The random turbulent velocity at the centre of the disk is 0.70 km/sec for the chromium line and 0.44 km/sec for the ionized barium line. For both lines the random turbulent velocity appears to increase toward the limb. The velocity shifts observed for the Hα and sodium D lines are of the same order of magnitude as those of the weaker metallic lines. The disk observations of the Fraunhofer lines of hydrogen and ionized calcium seem to be consistent with a qualitative model of the low chromosphere, consisting of relatively hot clouds of gas and with cooler regions both above and between the hot regions. Both the K_2 emission in ionized calcium and the wide absorption features in Hα seem to originate in the hot regions; from the appearance of these line features near the limb, it seems that the hot regions contribute a substantial fraction of the hydrogen and ionized calcium emission in the very low chromosphere. The profiles of Hα at the extreme limb and of the K line and other strong metallic lines on the disk favour the conclusion of Adams and Burwell that central self-reversal is a general characteristic of most strong chromospheric profiles. The similarity between the intensity and velocity fluctuations in the core of the strong magnesium line λ 5167 and in those of neighbouring weaker lines implies either a chromospheric origin for the centres of these weaker lines or the extension of the photospheric granules into the low chromosphere. The preliminary nature of the foregoing results is emphasized. A.

523.77

6320. THE WIDTH OF THE INFRARED HELIUM LINE IN THE SOLAR SPECTRUM. O.C.Mohler and L.Goldberg.
Astrophys. J., Vol. 124, No. 1, 13-19 (July, 1956).

Measurements of intensity and half-width are reported for the Fraunhofer line He I λ 10830. After correction for instrumental broadening and blending, the width at half-intensity, averaged over the centre of the disk and the four limbs, is 0.91 A. Within the error of measurement, the line widths show no centre-to-limb variation. The line appears to be broadened entirely by the Doppler effect, with $\Delta\lambda_D$ = 0.55 A, corresponding to an r.m.s. velocity of about 15 km/sec. If the broadening is entirely thermal, the kinetic temperature is about 50 000° K. Although the line is probably formed in localized hot regions of the chromosphere, it is not clear whether or not the derived velocity contains a turbulent, as well as a thermal, component. A.

523.774

6321. CENTRE-TO-LIMB VARIATION OF CURVES OF GROWTH ON THE SUN. M.Bretz.
Z. Astrophys., Vol. 38, No. 4, 259-301 (1956). In German.

Equivalent widths of about 150 weak, or moderately intense Fraunhofer lines of Ti, V, and Cr were evaluated from observations at the centre, and limb ($\sin\theta$ = 0.96, 0.98, 0.99) of the solar disk. These are used to construct curves which represent the centre-to-limb variation of the curves of growth for the above three elements. The results indicate departure from thermodynamic equilibrium in the sense of enhanced ionization at the upper photospheric levels.
D.R.Barber

523.85 : 523.164.4

6322. POLARIZATION IN THE JET OF MESSIER 87. W.Baade.
Astrophys. J., Vol. 123, No. 3, 550-1 (May, 1956).

The jet of M 87 is believed to be associated with the intense radio radiation of this object and photographic observations at the prime focus of the 200-inch telescope have established that radiation from certain strong condensations in the jet is strongly polarized, as is to be expected if the radiation arises from a synchrotron mechanism. M.W.Ovenden

523.854

6323. INTERSTELLAR POLARIZATION IN THE SOUTHERN MILKY WAY. E.van P.Smith.
Astrophys. J., Vol. 124, No. 1, 43-60 (July, 1956).

Polarization observations are reported for over two hundred stars in the southern Milky Way between longitudes 200° and 350°. Analysis of these and other data for the north seems to confirm the model of a polarizing medium where the elongated particles are aligned perpendicular to the spiral-arm axis. Light from stars in the Sagittarius or Perseus arms appears to acquire most of its polarization from dust clouds lying in the Orion arm. The amount of polarization per unit extinction is lower in the southern Milky Way than in the northern. Although the possibility of a difference in the optical properties of the grains is not ruled out, an alternative hypothesis seems preferable. It is suggested that the particles are more rigidly aligned in the centre of the spiral arm, through which the line of sight passes when we look northward, than at the periphery of the arm. Finally, individual regions in the southern Milky Way are discussed in detail, including Vela, Carina, the Coal Sack in Crux, and Scorpius. The Scorpius region, in particular, shows that local structure may considerably distort the general effect. A.

523.872

6324. CALCULATION OF ABSORPTION LINES IN STELLAR SPECTRA. H.van Regemorter.
C.R. Acad. Sci. (Paris), Vol. 242, No. 21, 2507-9 (May 23, 1956). In French.

A more rigorous generalization of Pecker's method (Abstr. 7487/1951), taking into account the variations of the damping constant with optical depth, which otherwise might cause errors > 10%. D.L.Edwards

523.877

6325. THE CHEMICAL COMPOSITIONS OF FIVE STARS WHICH SHOW SOME OF THE CHARACTERISTICS OF POPULATION II. E.M.Burbidge and G.R.Burbidge.
Astrophys. J., Vol. 124, No. 1, 116-29 (July, 1956).

Abundances of all or some of the elements Mg, Al, Ca, Sc, Ti, Cr, Mn, Fe, Sr, Y, Zr and Ba in the stars HD 84123, HD 106 223, λ Boo, HD 161 817 and 29 Cyg, relative to the standard population I star 95 Leo, have been obtained by curve-of-growth methods. These stars were all chosen because previous investigators had suggested that they had high-velocity characteristics or a general weakening of the spectral lines, which have been considered to be associated with stars of population II type, presently located in the solar neighbourhood. It has been found that, while HD 84 123 has a chemical composition practically indistinguishable from a normal population I star, λ Boo has a composition which is very similar to that of HD 19 445 and HD 140 283, studied by Chamberlain and Aller, which have only about 10 and 3%, respectively, of the "normal" abundances of Fe and Ca. In the other stars the under-abundance ratios for all the elements lie intermediate between

these two extremes. In HD 106 223 and λ Boo underabundance ratios of about 30 and ≥ 20 have been found for Ba, and these may be representative of the ratios for the very heavy elements. An attempt has been made to correlate the population II characteristics of these stars and of HD 19 445 and HD 140 283 in the following categories: (a) position on the HR diagram, (b) chemical composition, (c) kinematical properties, and (d) rotational properties. The theoretical implications of these results are discussed. A.

523.877

6326. LINE BROADENING IN THE SPECTRA OF O- AND EARLY B-TYPE STARS. A.Slettebak.
Astrophys. J., Vol. 124, No. 1, 173-95 (July, 1956).

Line profiles were measured from spectrograms of 10.2 A/mm dispersion for 43 stars of types O5-B2 and compared with theoretical line profiles computed under the assumption that axial rotation or large-scale atmospheric motions are responsible for the line broadening. Visual estimates of line broadening in the spectra of 110 additional O5-B5 stars were made for a statistical study of line broadening v. spectral type and luminosity class. Measures of the emission-line intensities in the O5-O8 stars suggest a correlation between the luminosity and the amount of emission for these stars. It was found that, with the observational material used, it was impossible to distinguish between axial rotation and large-scale atmospheric motions in a given star from a study of the line profiles. The statistical study of line broadening in the O5-B5 stars, however, yielded the following conclusions: (1) Large-scale atmospheric motions play an important role as broadening agents in the spectra of the O5-O8 stars of all luminosity classes and the high-luminosity stars of types O9-B1. (2) These large-scale atmospheric motions appear to increase with increasing temperature and increasing luminosity. (3) Axial rotation acts as an additional broadening mechanism for these stars but decreases with increasing luminosity at a given spectral type. (4) Among the O5-O8 stars both mechanisms probable act, but rapid axial rotation occurs more frequently in the stars of lower luminosity, while large-scale atmospheric motions dominate the line broadening in the stars of higher luminosity. (5) Among the O9-B1 stars the line broadening in the supergiant stars appears to be due almost entirely to large-scale atmospheric motions, while the line broadening in the main-sequence stars is due almost entirely to axial rotation. The O9-B1 stars of intermediate luminosity have lines broadened by both mechanisms. Large-scale atmospheric motions no longer dominate as line-broadening agents in the supergiant stars later than B1. A

523.87

6327. RADIATIVE EQUILIBRIUM OF A LINE-ABSORBING ATMOSPHERE. II. J.I.F.King.
Astrophys. J., Vol. 124, No. 1, 272-97 (July, 1956).

For Pt I see Abstr. 5843 (1955). The transfer theory of nongrey atmospheres of finite thickness is developed. This planetary thermal problem is treated by using both an invariance attack and the method of discrete ordinates. The emergent intensity, corresponding vertical thermal structure and constants of the problem are expressed in exact form in term of nongrey X- and Y-functions and their moments. The alterr ative method of discrete ordinates is used in parallel fashion, the elimination of constants is achieved and equivalent expres sions are obtained for the X- and Y-functions and their moments in quotient polynomial form. A

525.35

6328. DAMPING OF THE EARTH'S FREE NUTATION. B.Gutenberg.
Nature (London), Vol. 177, 887-8 (May 12, 1956).

The poles of the earth describe changing orbits with the Chandler period of about 14 months and in every 6 or 7 years the amplitude of these orbits reaches a maximum of up to 10 m and decreases almost to zero. Bondi and Gold consider ed the free nutation has a characteristic damping time of about 10 periods and conclude that it results from non-elastic behaviour of the mantle. Schweydar's view is that the form and amplitudes of the observed motion of the poles is approximately a beat phenomenon between the free Chandler period of the earth of about 14 months and a periodic annual displacement of the earth's axis of inertia due to the movements of air masses from one hemisphere to the other. These produce dis placements of the poles of inertia with an average annual range on roughly 3 m but with variations from year to year. This is enough to explain the amplitude of the nutation. However, observations of the uplift in formerly glaciated areas and the existence of deep-focus earthquakes indicate a mean time of viscous relaxation in the upper 700 km of the earth's mantle of at least 100 years. The period of about 7 years for the increase and decrease of the amplitudes of the free nutation is short compared with the damping time of the nutation. As also the energy transfer from atmospheric and other processes to the Chandler motion is unknown it is not considered possible to interpret the decay curve of the nutation and to discriminate the effect of damping from the beat phenomenon. R.S.Read

PHYSICS 53

53 : 518.42

6329. THE SUCCESSIVE DIFFERENTIATION OF EXPERIMENTAL LAWS. P.Vernotte.
C. R. Acad. Sci. (Paris), Vol. 242, No. 16, 1966-8 (April 16, 1956). In French.

See Abstr. 4771 (1956). The first derivative is usually determined by the first difference divided by h, and the second derivative by the second difference divided by h^2, where h is the abscissa interval between the ordinates of the experimental points defining the law, but in order to reduce the abrupt variation in the individual points it is considered advantageous to skip (p-1) ordinates in p when calculating the differences. S.Weintroub

53.089 : 621.317.7

6330. THE LANGUAGE OF INSTRUMENT CALIBRATION AND PERFORMANCE. K.M.Greenland.
J. sci. Instrum., Vol. 33, No. 7, 249-54 (July, 1956).

A critical discussion is presented of the terms used in describing the establishment of instrument scales and the performance of measuring instruments. Examination of a number of vocabularies and of unrecorded usage shows that many of the important terms have more than one meaning. Arguments are put forward in support of certain unique definitions consistent, wherever possible, with the original sense of the words. The discussion takes as a basis the new definitive glossary compiled by the British Standards Institution (B.S. 2643: 1955). A.

FUNDAMENTALS 530.1

530.12

6331. RELATIVISTIC DEFLECTION OF SUN'S LIGHT BY THE MASS OF THE SUN. S.N.Milford.
Astrophys. J., Vol. 123, No. 1, 182 (Jan., 1956).

From a consideration of the deflection of light in a

chwarzschild field, it is shown that the relativistic correction o the observed angular diameter of the sun amounts to x 10^{-3} sec. R.A.Newing

530.12

332. RECIPROCAL STATIC SOLUTIONS OF THE EQUATIONS OF THE GRAVITATIONAL FIELD. H.A.Buchdahl. Australian J. Phys., Vol. 9, No. 1, 13-18 (March, 1956).

Deals with reciprocal static line-elements, previously defined by the author, the condition that their Ricci tensors vanish being no longer imposed. If the indices i, k run from to n with the exception of the fixed index a (the line-elements being static with respect to x^a) a certain quantity Q^{ν}_{μ} appears with the remarkable property that in a reciprocal transformation Q^k_1 is invariant, whilst Q^a_a merely changes sign. Q^{ν}_{μ} is closely related to the Hamiltonian derivative of the Gaussian curvature, so that the general results obtained may be applied to the field equations of General Relativity Theory, with n = a = 4. Q^4_1 is then the total energy density; and formally every static distribution of matter has a "reciprocal distribution" associated with it. In particular, the equation of state of a distribution of fluid reciprocal to a distribution of fluid possessing a given equation of state may be obtained directly from the latter, i.e. without the solution of the field equations being known. A.

530.12 : 523.11

333. CHRONOMETRIC INVARIANTS AND REST SYSTEMS IN THE GENERAL THEORY OF RELATIVITY. A.L.Zel'manov.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 6, 815-18 (1956). In Russian.

For the purpose of application to cosmological problems the covarianace of physical quantities relative to a restricted class of space-time transformations is investigated. The result is a self consistent set of equations not unlike the special theory of relativity. Only those transformations are considered in which the space-like dimensions are transformed independently of the time. R.Eisenschitz

530.12

6334. RELATIVISTIC THEORY OF POLARIZATION PHENOMENA. H.P.Stapp.
Phys. Rev., Vol. 103, No. 2, 425-34 (July 15, 1956).

A covariant form of the polarization formalism of Wolfenstein and Ashkin is developed. After the hole-theory boundary conditions are incorporated, the theory may be transformed into a form in which the positive- and negative-energy components are separated. This form involves two-by-two matrices of the Pauli type and its similarity to the form of the nonrelativistic equations allows the relativistic contributions to be extracted. It is concluded that, with suitable interpretations, the nonrelativistic formalism may be used if an additional rotation of the polarization vector is added at each scattering. The relativistic forms of the Wolfenstein equations for various polarization parameters are then derived. A.

530.12

6335. ISENTROPIC HYDRODYNAMICS IN PLANE SYMMETRIC SPACE-TIMES. A.H.Taub.
Phys. Rev., Vol. 103, No. 2, 454-67 (July 15, 1956).

Use is made of a form of the stress energy tensor of a perfect fluid, previously derived for special relativity, to show that for irrotational isentropic motions a co-moving coordinate system exists in which both sides of the Einstein gravitational field equations may be expressed in terms of the dependent variables of the self-gravitational problem for a perfect fluid. It is shown that for a space-time with plane symmetry the field equations and the assumption of isentropy imply the conservation of mass. General methods for dealing with these field equations are given for the static and spatially independent cases. Approximate solutions are obtained for other specific cases. The general exact solution is obtained for the incompressible case. Properties of the incompressible case are discussed. A.

530.12

6336. ON THE SOLUTION OF Γ'S FOR A TYPE OF NON-SYMMETRIC TENSOR FIELD $g_{\mu\nu}$. N.N.Ghosh.
Progr. theor. Phys., Vol. 13, No. 6, 587-93 (June, 1955).

Solution of 64 non-symmetric Γ's corresponding to three special types of tensor field $g_{\mu\nu}$ is obtained in a simple form which includes, in particular, the spherically symmetric fields. Using general symbols k, l, m, n instead of 1,2,3,4 and starting with the system of 24 fundamental equations given by Bose, the complete solutions for all the three cases are arrived at by a uniform treatment, when only a set of four simultaneous equations has been solved. Simplified forms of $R_{\mu\nu}$ corresponding to these cases are also obtained so as to construct the relevant field equations. A.

530.12 : 531.51

6337. APPLICATION OF ARTIFICIAL SATELLITES FOR TESTING GENERAL RELATIVITY. V.L.Ginzburg.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 213-14 (1956). In Russian.

According to theory there is a violet shift of the frequency of radio signals emerging from the satellite owing to the earth's gravitational field. Also there is a precession of the satellite's perihelion in the field of the earth. Both effects are discussed quantitatively; they appear to be large enough for observation. In considering the precession of the perihelion the effect of the earth's rotation has to be taken into account. R.Eisenschitz

530.145

6338. TABLES OF U COEFFICIENTS. H.Matsunobu and H.Takebe.
Progr. theor. Phys., Vol. 14, No. 6, 589-605 (Dec., 1955).

The U coefficient arises in the relation between different ways of coupling the four vectors to give a resultant. When the coupling of the angular momenta of two spin 1/2 particles comes into question, there often appear U coefficients of the following form:

$$U\begin{pmatrix} l & l' & L \\ j & j' & J \\ 1/2 & 1/2 & S \end{pmatrix},$$

where l, l' are integers. The well-known cases of the appearance of such coefficients are the transformation coefficients between LS and jj coupling scheme of two equivalent particles, β-decay correction factor, nuclear matrix elements for β-decay and so on. Algebraic formulae and tables of U coefficients of the above form, when L or J range between 0 and 4, and j and j' between 1/2 and 7/2, are given. A.

530.145

6339. HAMILTONIAN FORMALISM AND CANONICAL COMMUTATION RELATIONS IN THE CASE OF FIRST ORDER LAGRANGE EQUATIONS. W.Hanus.
Acta phys. Polon., Vol. 14, No. 4, 309-21 (1955).

The problem of the Hamiltonian formalism in the case of first-order equations of motion is investigated on a dynamical model with a finite number of degrees of freedom. The possibility is shown of introducing canonically conjugate variables to the generalized coordinates q_j by the usual definition $p_j = \partial L/\partial \dot{q}_j$, in spite of their dependence on q_j, provided that a suitable symmetrization is performed. The relations between the q's and p's are interpreted as a canonical transformation independent of time. The canonical quantization with the aid of the correspondence principle (exploiting the properties of the Poisson brackets) is proved to be possible in this case in spite of the mutual dependences of q and p. The correct canonical commutation relations with the factor ½ are obtained. The admissibility of treating the relations between the p's and

q's as a canonical transformation is restricted to only one of the infinitely many Lagrangians giving the same equations of motion, i.e. differing by terms of the form of a time derivative, namely to the Lagrangian symmetrical with respect to integration by parts. This form of the Lagrange function (connected with the canonical commutation relations possessing a factor $\frac{1}{2}$) is thus distinguished. Moreover, two other special forms allowing an immediate elimination of one half of the variables q are distinguished too; then the remaining canonical variables, already independent, fulfil the usual commutation relations without the factor $\frac{1}{2}$. These considerations are generalized for the known cases of fields obeying first-order field equations (Dirac and Kemmer fields). A.

530.145

6340. PRODUCTS OF IMPROPER OPERATORS AND THE RENORMALIZATION PROBLEM OF QUANTUM FIELD THEORY. W.Güttinger.
Progr. theor. Phys., Vol. 13, No. 6, 612-26 (June, 1955).

A theory of products of "improper" operators in quantized field theories is developed. Especially the meaning of products such as δ^2, $\delta\chi^{-1}$, $S_F D_F$, $\psi\bar{\psi}$ etc. is clarified. It is shown that a theory of products of such quantities is generally neither commutative nor associative. It can be proved that there exists no generalized analysis of any kind which yields perfectly unique products of improper operators. On the basis of this product theory the mathematical foundation of the renormalization formalism is given and it is shown that it is in principle impossible to get uniquely determined values of the proper constants of a quantum theoretical system within the current field theoretical formalism. Finally it is pointed out, how a "self-quantized" field theory may be constructed without reference to matrix representation by the new operator algebra. Every field theory — to be based upon an exaxt definition of operator products — deviates from the present quantum theory but encloses the renormalization formalism as a limit of it. A.

530.145

6341. MULTILINEAR ALGEBRA AND THE QUANTIZATION OF THE PHOTON FIELD. D.Kastler.
C.R. Acad. Sci. (Paris), Vol. 242, No. 20, 2445-8 (May 14, 1956). In French.

The method described in a previous note (Abstr. 5682/1956) is applied to the photon field and leads naturally to the indefinite metric of Gupta (Abstr. 6997/1950) and Bleuler (Abstr. 69/1951). P.T.Matthews

530.145

6342. ON QUANTUM ELECTRODYNAMICS WITHOUT SUBSIDIARY CONDITIONS. S.Ozaki.
Progr. theor. Phys., Vol. 14, No. 6, 511-22 (Dec., 1955).

The formalism of quantum electrodynamics without subsidiary conditions was obtained in a relativistically covariant way, starting from Heisenberg's representation. Transforming the formalism of quantum electrodynamics in Heisenberg's representation to the one in the interaction representation, the equivalence of this formalism to the ordinary quantum electrodynamics introduced by Fermi was proved. A.

530.145

6343. A RELATIVISTICALLY INVARIANT FORMULATION OF ELECTRODYNAMICS WITHOUT LONGITUDINAL AND SCALAR FIELDS. É.M.Lipmanov.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 583-4 (1956). In Russian.

A quantized extension of the classical formulation (Abstr. 721/1955) is derived in the Heisenberg representation from a variational principle. G.E.Brown

530.145

6344. ON CUT-OFF AND NON-LOCAL THEORIES. P.Budini.
Nuovo Cimento (Ser. 10), Vol. 3, No. 4, 835-6 (April, 1956).

A covariant non-local theory is proposed, based on the extended source pseudovector theory. The corresponding Tamm–Dancoff equation for meson–nucleon scattering differs from the usual one in having an extra S-wave contribution. P.T.Matthews

530.145

6345. RELATIVISTIC RADIATIVE TRANSITIONS. J.S.Levinger and M.L.Rustgi.
Phys. Rev., Vol. 103, No. 2, 439-42 (July 15, 1956).

The summed oscillator strength for a K electron in the Coulomb field of a lead nucleus is calculated, using calculations of the oscillator strength for discrete transitions, and the oscillator density for absorption to the continuum. 86% of the value unity given by the nonrelativistic Thomas–Reiche–Kuhn sum rule is obtained. Dispersion theory is also used to calculate the forward scattering amplitude as a function of photon energy. Numerical values for the forward scattering amplitude are in good agreement with Brown's values for a K electron of mercury at 1.7, 3.4 and 6.8 times the binding energy. Comparison is made with calculations by the authors of the forward scattering amplitude by a nonrelativistic electron in a Coulomb field. A.

530.145

6346. ON THE THEORIES OF HIGHER DERIVATIVE AND NON-LOCAL COUPLINGS. I. T.Taniuti.
Progr. theor. Phys., Vol. 13, No. 5, 505-21 (May, 1955).

The initial value problems for field equations (in mechanics, equations of motion) with higher derivative or non-local couplings are investigated on the basis of the perturbation theory. In particular the paper aims at clarifying the deduction of all higher derivatives of dynamical variables from the prescribed initial values of the same degrees of freedom as those of free equations. The propagation character of those field are also investigated, applying the characteristic theory of hyperbolic differential equations. A.

530.145

6347. INTERACTION BETWEEN NUCLEON AND ANTI-NUCLEON. Yu.A.Tarasov.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 603-5 (1956). In Russian.

This interaction is investigated using the old method of Tamm. G.E.Brown

530.145

6348. INTRODUCTION TO THE BILOCAL THEORY OF ELEMENTARY PARTICLES. J.Rayski.
Acta phys. Polon, Vol. 14, No. 4, 337-64 (1955).

A generalized field formalism (closely connected with that of Yukawa) incorporating a fundamental length l may be regarded as a new type of field quantization: the "l-quantization" to be distinguished from the canonical "h-quantization". The l-quantization appears to be the mass and spin quantization and leads to a rotator (or spinrotator) model of elementary particles. The particle is represented by (the surface of) a sphere of radius l^2M (M being the rest mass). The general solution of the (first- or second-order) field equation includes a whole family of particles with higher spins and masses. A close connection with Fierz's theory of higher spins is discussed. The particles are classified in families and super-families according to the type of the field equations (of the first- or second-order) and the type of parity. Four families of bosons and six families of fermions follow from general group-theoretical considerations. There exists a homomorphism between all single and multi-values irreducible representations of the group of rotations and inversions and the possible types of elementary particles. All sorts of particles known at

resent (light fermions, light and heavy mesons, nucleons, hyperons) fit into our scheme except the photons (and gravitons) which have to be considered separately. Qualitative properties decay schemes, etc.) are explicable in terms of selection rules due to the conservation of angular momentum and parity. Theoretical values of the masses which follow from this formalism agree in some cases remarkkably wellwith experiment. In the remaining few cases (μ, π, $\Omega^{\pm}$) the agreement is only rough but the discrepancies are probably caused by a "fine structure" of the mass levels (self-masses) due to interaction. A.

530.145

6349. FREE PARTICLE WITH SPIN: USE OF THE OPERATOR OF UMEZAWA AND VISCONTI IN OUR COVARIANT FORMALISM OF TRIPLE INTEGRALS. O. Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 1692-4 (March 26, 1956). In French.

530.145

6350. NON-LINEAR GENERALIZATION OF DIRAC'S SPINOR EQUATION. D.Ivanenko and M.Mirianashvili.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 3, 413-14 (1956). In Russian.

A system consisting of electrons and nucleons, or, generally, of two types of fermions, is specified in terms of two field equations of the form of Dirac's equation with a non-linear interaction term. Elimination of one of the field-variables from one of the equations leads to a non-linear equation for a single type of particles the form of which has been known previously. Problems of renormalization in connection with this equation are discussed and estimates of the numerical values of coupling constants are attempted.
R.Eisenschitz

530.145

6351. THE STRUCTURE OF THE NUCLEON. S.Fubini.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1425-32 (June, 1956).

From fixed source meson theory an exact relation is derived connecting the structure of the physical nucleon to the meson-nucleon scattering amplitudes. General formulae are obtained for the charge and current densities of the meson cloud of the nucleon. Using these results it is possible to obtain an upper limit of 5.5 meson masses for the cut-off and of 1.65 for the average number of mesons in the cloud. The nucleon magnetic moments take the correct experimental values $\pm$ 1.9 in correspondence of a cut-off to 5 meson masses. A.

530.145

6352. AN ATTEMPT IN THE THEORY OF ELEMENTARY PARTICLES. T.Tati.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 75-87 (July, 1956).

A quantum mechanical formulation of the fundamental law of Nature without using the space-time co-ordinates is presented. Matter is composed of various kinds of particles, each kind of which has the co-ordinate spaces characterized by the intrinsic quantities (m, σ) of the particle. (The co-ordinate space characterized by the mass m is the four dimensional momentum space of the particles of mass m). Probability amplitudes are functionals of the numbers of particles specified by their kind (m, σ) and co-ordinates. Phenomena are the transitions between the particles. The causality principle in this theory is the principle of the existence of the $\mathfrak{w}$-matrix. The element $\mathfrak{w}_{ji}$ means the probability of finding the state i in the observation O_1 of the observable Ω_1, and then the state j in the observation O_2 of the observable Ω_2, when the system characterized by an operator $\mathcal{H}$ is observed; and $\mathfrak{w}$ has the form $\mathfrak{w} = C(O_1;O_2)W[\mathcal{H}, \Omega_1, \Omega_2]$, where W is the matrix determined by $\mathcal{H}$, Ω_1 and Ω_2, and C is the undetermined quantity independent from $\mathcal{H}$, Ω_1 and Ω_2. From this causality principle, T(p) is introduced using an ideal p-meson clock. Then the undetermined $C(O_1, O_2)$ is expressed as $C(O_1, O_2) = (2\pi/\hbar)T(p)$ with a universal constant $\hbar$ which has a dimension of [energy] x [T]. The formulation is described keeping the relation to the current theory as close as possible. A.

530.145

6353. REDUCTION OF THE DIRAC EQUATION. J.Sucher.
Phys. Rev., Vol. 103, No. 2, 468 (July 15, 1956).

A method is given for reducing the Dirac equation for an electron in an external field to small components, leading to reduced equations linear in the time-derivative operator. A.

530.145

6354. ON THE JAUCH FIELD. S.Kamefuchi and S.Tanaka.
Progr. theor. Phys., Vol. 14, No. 3, 225-42 (Sept., 1955).

Discussion of a field recently suggested by Jauch for neutral particles. Lagrangian and Hamiltonian formulation of the Jauch field is obtained, which leads to the required anticommutators given by Jauch. The Jauch field shows an intermediate nature between the Dirac and the Majorana fields, but it is shown that contrary to Jauch's conclusion it can be a charged field with gauge invariant electromagnetic interaction. The gauge and Lorentz transformations of this field are examined, which again lead to results contrary to those of Jauch. Interaction terms are introduced and as an example the application to β-decay neutrino is discussed. It is concluded that the Jauch field is essentially equivalent to the Dirac field and so in general the problem of this field should be considered from the view-point of the structure of interactions of the Dirac field. It is pointed out, however, that in some circumstances the Jauch field may more suitably describe the physical reality than the Dirac field. In the Appendix some remarks are given on the quantization of the Majorana field. A.

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6355. THE VECTOR REPRESENTATION OF SPINNING PARTICLE IN THE QUANTUM THEORY. I. T.Takabayasi.
Progr. theor. Phys., Vol. 14, No. 4, 283-302 (Oct., 1955).

For a preliminary condensed account, see Abstr. 6765/1955. A quantum-mechanical non-relativistic spinning particle is represented equivalently by a non-linear vector field which defines a new kind of hydrodynamics of a spinning fluid. In this hydrodynamics, quantum effects are separated as non-linear terms which mean the occurrence of "internal potential" and "internal magnetic field". Mathematically, the method is based upon the replacement of the original calculus in terms of a spinor ψ by the calculus in terms of tensors formed as bilinear expressions in ψ^* and ψ. This replacement is achieved by setting up the identities which should hold among those tensor quantities. A.

530.145 : 530.162

6356. ON THE EXTENSION OF THE CASIMIR TRICK. I. ON THE DEFINITION OF DENSITY MATRIX AND ITS REDUCTION. T.Kotani.
Progr. theor. Phys., Vol. 14, No. 4, 379-95 (Oct., 1955).

When a fermion is described by a plane wave, quantities which are to be compared with experimental data can be computed easily by using the well-known Casimir trick. But, when the influence of interaction of the fermion with another field is taken into account, the calculation becomes very difficult. As the Casimir trick cannot be used, complicated calculations have hitherto been necessary. It is the purpose of this paper to give a method of calculation in which the density matrix, instead of the Casimir operator, is used in the case of a fermion moving in an arbitrary central field. This density matrix will be represented as a sum of direct products of ρ- and σ-operators with numerical coefficients. It is also verified that, for a free fermion, the density matrix defined in this paper is reduced exactly to the usual Casimir operator (projection operator). The method of calculation proposed in this paper can be employed to treat such various problems as β-decay, Bremsstrahlung and so on where the influence of the central

potential must be considered, and is is also useful in solving the problem of free fermions by the method of partial waves. A.

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6357. REAL SPINORS IN CURVILINEAR COORDINATES AND PSEUDO-RIEMANNIAN SPACE. G.A.Zaĭtsev.
Zh. éksper. teor. Fiz., Vol. 29, No. 3(9), 345-53 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 290-6 (March, 1956).

Properties of matrix-tensors are utilized for the investigation of real spinors in curvilinear coordinates. It is shown that one need not replace ordinary derivatives of spinors by more general derivatives. In connection with this, contrary to the opinion that is widely held, the equations of Dirac and other analogous relativistically invariant differential equations, by nature, do not change their form in transformation into curvilinear coordinates. The problem of generalization to the case of pseudo-Riemannian space is considered. It is significant that one can explain the appearance of a term with the factor $m_0c/\hbar$ in the equation of Dirac, if we regard the space, not as pseudo-Euclidian, but as pseudo-Riemannian. A.

530.145

6358. THE SOLUTION OF THE PROBLEM OF THE MOTION OF THREE NUCLEONS IN THE LIMITING CASE OF SHORT-RANGE FORCES. G.V.Skornyakov and K.A. Ter-Martirosyan.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 3, 425-8 (1956). In Russian.

The short-range internucleon potential is written as $U(r) = -4\pi(\hbar^2/M)r\delta(r)$. In this limit the wavefunction $\Psi(r_1, r_2, r_3)$ for arbitrary separations of the particles can be expressed in terms of its values $\chi(r)$ when two of the particles are at the same point. The boundary conditions can also be expressed in terms of $\chi(r)$. The Fourier coefficients $\chi(k)$ for a state of particular angular momentum satisfy a one-dimensional integral equation. The method is illustrated by a calculation of the cross-section at zero energy for the elastic scattering of neutrons by deuterons. The calculated cross-section is $\sigma = 2.55$ barns. The experimental value is $\sigma = 3.4 \pm 0.06$ barns. J.M.Radcliffe

530.145

6359. EVALUATION OF THE CROSS-SECTION TRANSFORMATION MATRICES OF ZWEIFEL AND HURWITZ. H.Amster.
J. appl. Phys., Vol. 27, No. 3, 307 (March, 1956).

The evaluation of the Legendre polynomial expansion coefficients of a differential cross-section in the laboratory system from those in the centre-of-mass system can be facilitated by an explicit formula given here for the lowest angular momenta and recurrence relations for the higher ones.
G.E.Brown

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6360. A HIGH ACCURACY APPROXIMATION FOR SOLVING MULTIPLE SCATTERING PROBLEMS IN INFINITE HOMOGENEOUS MEDIA. C.C.Grosjean.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1262-75 (June, 1956).

Making use of a previous result (Abstr. 3138/1954), an approximate formula describing the steady-state density of isotropically scattered particles emitted by a point source in an infinite homogeneous medium is obtained and compared with the exact distribution. The agreement is remarkably good for all values of the parameters. Without being more complicated, the present approximation turns out to be much better than the formulae previously derived from other approximate theories. In an infinite homegeneous medium, it can be applied in the calculation of the particle density in the presence of a given source distribution. The method by which the formula has been deduced, permits a direct generalization to the case of non-isotropic scattering. Attention is drawn upon the fact that the results obtained could be of basic importance in the development of a more complete formalism, which would also permit the solution of multiple scattering problems in finite media with the same high accuracy. A

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6361. THE COUPLING CONSTANT OF p-WAVE PION NUCLEON SCATTERING. M.Cini, S.Fubini and A.Stanghellini.
Nuovo Cimento (Ser. 10), Vol. 3. No, 6, 1380-6 (June, 1956).

Using the experimental data for the phase-shift δ_{33} of the pion–nucleon scattering, in the Low equation, the renormalized p-wave coupling constant f^2 has been determined, and found to be: $f^2 = 0.107 \pm 0.006$. The reliability of this result is discussed. A.

530.145

6362. A SOLUBLE MODEL OF MESON–NUCLEON S-STATE SCATTERING. E.L.Lomon.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 106-22 (July, 1956).

The following interaction Hamiltonian is considered:

$$(1)\quad H_I = g\int d_3x\,\bar{\psi}(x)\varphi(x)\cdot\varphi(x)\,\psi(x) + \lambda\int d_3x\,\bar{\psi}(x)(\pi(x)\times\varphi(x))\cdot\tau\,\psi(x),$$

g and λ coupling constants; ψ, $\bar{\psi}$ and φ, π are the field operators and their canonical conjugates for the nucleon and meson fields respectively. There is evidence that for meson–nucleon scattering (1) represents a large part of the ps(ps) s-state interaction for intermediate as well as weak coupling, providing that λ/g is suitably altered. The first term of (1) has long been known to be diagonalizable in the static nucleon limit. The isotopic spin coupling of the second term requires that the isotopic spin variable of the nucleon be left free (non-static) thus complicating the diagonalization. By combining the nucleon spin operator with the meson field operators (1) can be diagonalized. The parameters determined by experiment are reasonable. One can examine many formal aspects. The point source limit exists. A.

530.145

6363. NEUTRON–ELECTRON INTERACTION IN CUTOFF THEORY. S.B.Treiman and R.G.Sachs.
Phys. Rev., Vol. 103, No. 2, 435-9 (July 15, 1956).

The perturbation-theoretic result for the neutron–electron interaction, as calculated by Salzman in the Chew no-recoil theory, is in serious disagreement with experiment. The main part of the experimental interaction (~ 4.2 keV) is accounted for by the Foldy term (4.08 keV). But the latter is not included in the no-recoil approximation, where one calculates only the electron interaction with the static pion cloud of the physical neutron. For this part of the interaction the no-recoil perturbation result is too large by a factor of at least twenty. The possibility that higher-order corrections drastically alter the pion cloud charge distribution is here investigated. Using the techniques developed by Miyazawa, one can express the higher-order corrections in terms of weighted integrals over the pion–nucleon interaction cross-sections. It is found that the higher-order effects indeed reduce the pion cloud contribution, but only by 20%. Because of certain ambiguities involved in treating the cutoff function, it cannot be stated that this represents the true content of Chew's theory; but it seems unlikely that any reasonable treatment of the cutoff could reduce the discrepancy much further. A.

530.145

6364. APPROXIMATION METHOD FOR HIGH-ENERGY POTENTIAL SCATTERING. L.I.Schiff.
Phys. Rev., Vol. 103, No. 2, 443-53 (July 15, 1956).

An approximation method for high-energy potential scattering is developed that expresses the scattered amplitude in terms of a quadrature, similar to the Born approximation but superior to it in accuracy. It is valid when the potential is slowly varying compared to a wavelength, $|V|/E'$ is small compared to unity, θ is either small or large compared to

$\kappa R)^{-1/2}$, and $|V|R/\hbar v$ is unrestricted in magnitude, where E', , k and v are the kinetic energy, scattering angle, wave number, and speed of the scattered particle, and V and R are ough measures of the strength and range of the scattering otential, which may be complex. For comparison, the Born pproximation requires that $|V|R/\hbar v$ be small compared to nity. The procedure consists in summing the infinite Born eries after approximating each term by the method of station- ry phase. Both the Schrödinger and Dirac equations are reated, and it is expected that the method can be extended to he scattering theory of other wave equations. The relation of he present work to previous work of others is discussed, and he limitations of WKB or eikonal-type approximations are xplored. The method is expected to be especially useful for alculating the scattering of fast electrons, neutrons and rotons from nonspherical nuclei. A.

530.145

6365. ADIABATIC PROCESS AND THE STATIONARY STATE. H.Tanaka.
Progr. theor. Phys., Vol. 13, No. 5, 497-504 (May, 1955).

The transformation function has singularity when the interaction has been switched off adiabatically. A procedure to remove this singularity is presented. As a result of this procedure the displacement of energy spectrum of the total Hamiltonian from that of the free Hamiltonian can be found. A.

530.145

6366. ON THE INTERMEDIATE COUPLING THEORY OF PSEUDO-SCALAR MESON FIELD AND A NUCLEON. D.Itô, Y.Miyamoto and Y.Watanabe.
Progr. theor. Phys., Vol. 13, No. 6, 594-602 (June, 1955).

The properties of the proper field around a nucleon are investigated by Tomonaga's theory of intermediate oupling applied to pseudo-scalar field, and the phase shifts of pion-nucleon scattering and the anomalous magnetic moment of a nucleon are calculated. A.

530.145

6367. ON THE ANALYSIS FOR THE PROPER FIELD OF A NUCLEON. Y.Watanabe.
Progr. theor. Phys., Vol. 13, No. 6, 603-11 (June, 1955).

Making use of the symmetrical scalar theory various approximations for analysing the properties of the proper fields of a nucleon are developed. As this model permits the exact numerical solution of the proper field equation, it is possible to test the accuracy of newly attempted approximation methods. The exact numerical solution for the proper field of the nucleon is also given. A.

530.145

6368. NONADIABATIC TREATMENT OF NUCLEAR FORCES. II. NONSTATIC CORRECTIONS. J.Iwadare.
Progr. theor. Phys., Vol. 14, No. 1, 16-26 (July, 1955).

For Pt I see Abstr. 79 (1956). The nonstatic corrections to the second plus fourth order potentials are studied in the symmetrical Ps(ps) meson theory. The potentials are constructed by means of canonical transformation, and the nonstatic corrections are obtained by the use of the expansion in powers of $(p/2M) \sim (k/2M) \sim (\mu/2M)$, the validity of which is examined for the special case of the no-pair contributions. The nonstatic corrections are negligible for the large separation $\lambda > 1/\mu$ between two nucleons, and are large in the interior region but would not alter the main features of the static potentials except for the central force in triplet odd state and the one-pair contributions. The results for the small separation should be accepted only qualitatively because of the inadequacy of the power series expansion in this region. It is shown that the separation of the no-pair contributions from the one- and the two-pair contributions leads to unreasonable results for the velocity dependent potentials, and that the more careful treatment is needed for the inclusion of the effects of the pair suppression. The spin-orbit coupling in the two-pair contributions obtained by Klein is found to be cancelled by the inclusion of the one-pair contributions. Finally, it is remarked that the potentials determined by this canonical transformation give the correct results for the scattering problem up to g^4. A.

530.145

6369. ON THE MESON-THEORETICAL POTENTIALS. S.Otsuki and R.Tamagaki.
Progr. theor. Phys., Vol. 14, No. 1, 52-64 (July, 1955).

Properties of the second-order nuclear potentials derived from the symmetrical pseudoscalar meson theory are examined with respect to such phenomena that the fourth- and higher order nuclear forces do not play a serious role. Information from p–p scattering at low and intermediate energies furnishes a strong confirmation of the second-order potentials. Corrections to the second-order potentials which are required by the experimental data are estimated and are found to be not inconsistent with the fourth-order potentials. A.

530.145

6370. DOUBLE MESON PRODUCTION IN THE INTERMEDIATE-COUPLING THEORY. I. A.Komatsuzawa, Y.Munakata and H.Hasegawa.
Progr. theor. Phys., Vol. 14, No. 1, 65-74 (July, 1956).

The intermediate-coupling theory is applied to the problem of the meson production in meson-nucleon collisions. For simplicity, the model used is a charged scalar meson field interacting with a fixed nucleon. The amplitudes of the ordinary scattering and the meson production are obtained in the "one-level" approximation. A.

530.145

6371. THE FORMAL THEORY OF SCATTERING. S.Sunakawa.
Progr. theor. Phys., Vol. 14, No. 3, 175-97 (Sept., 1955).

The time-dependent theory of scattering is reformulated. It is developed on the basis of a new limiting process which is self-consistent, and it is shown that Heisenberg's S-matrix and Dyson's are equivalent, when the total Hamiltonian permits the existence of bound states. The theory of scattering of a wave packet is proposed in conformity with the physical picture. The damping factor $e^{-\epsilon|t|}$ is derived from the amplitude of the wave packet. The rearrangement scattering is treated on the basis of the wave packet formalism. A.

530.145

6372. PHENOMENOLOGICAL ANALYSIS OF ELASTIC π^-–p SCATTERING AT 1.4 BeV. D.Itô and S.Minami.
Progr. theor. Phys., Vol. 14, No. 3, 198-202 (Sept., 1955).

Pion–proton scattering at 1.4 BeV observed by Eisberg et al. (Abstr. 3085/1955) is analysed in a phenomenological way. Interpreting the peak in forward direction as "shadow scattering" and analysing this angular distribution, a result is obtained which agrees fairly well with experiment. By this method, moreover, it is found that the partial waves of l = 0, 1, 2, 3, 4 are mainly responsible for the elastic and production cross-sections, respectively. A.

530.145

6373. SOLUTIONS OF A BETHE-SALPETER EQUATION FOR SCATTERING STATES. K.Nishijima.
Progr. theor. Phys., Vol. 14, No. 3, 203-13 (Sept., 1955).

A complete set of scattering-state solutions of the Bethe–Salpeter equation is obtained in this paper. This equation is the one for which Wick and Cutkosky obtained the bound-state solutions. For bound-state solutions, they have found the same degeneracy as that of the non-relativistic hydrogen atom. This result is very suggestive for the present case, and indeed the scattering-state solutions are obtained without decomposing them into partial waves as is the case for Rutherford scattering. Adopting the integral transformation method, the four-dimensional integral equation is reduced to a simple ordinary differential equation. It is interesting to see that this equation is identical with Cutkosky's for n = 0. Finally by a close

inspection of the resulting equation and of the boundary condition, it is shown that the virtual-state solutions, if any, can be obtained by modifying the inhomogeneous boundary condition for scattering states into a homogeneous one. Furthermore, it is proved that an isolated virtual level, if it really exists, gives rise to a resonance scattering. A.

530.145

6374. CONNECTION OF THE STRONG COUPLING THEORY WITH THE WEAK COUPLING THEORY IN THE BOUND MESON PROBLEM. THE SYMMETRICAL SCALAR THEORY. S.Tani and W.Watari.
Progr. theor. Phys., Vol. 14, No. 3, 243-59 (Sept., 1955).

The bound meson problem is studied in the p-representation of meson oscillators (p is the canonical momentum). The notions of this paper may be applied to problems other than the symmetrical scalar one. The domain of p is divided into the inner and outer regions. It is proved by application of canonical transformations that such a process is natural. In the inner region the precession of the τ-spin, which takes place as bound mesons are virtually emitted or absorbed, is dominant. On the other hand, in the outer region the coupling between the radial mode of meson with the τ-spin is primarily important. Since all the relevant quantities appear as functions of $V|p|$ (V is the coupling constant), one can speak about the characteristics of regions independently of V, if we choose $1/V$ as the unit of length of p. Then on this scale, the wave functions of low-lying states are damped when the magnitude of $|p|$ is larger than V. In the weak coupling case, the inner region is the only one to be taken into account, while the most noticeable features of the strong coupling case come from the outer region, to which the major part of a wave function belongs in this case. It is noticeable that the inner region is, however, essential to give finer details of the strong coupling case, which are of higher order in $1/V^2$. With these qualitative prospects in mind, a new approach is tried to improve the results worked out by Sawada. However, due to the complicated form of the operators the results are not yet satisfactory. A key to future improvements is discussed. A.

530.145

6375. ON THE RECOIL CORRECTION TO ADIABATIC NUCLEAR POTENTIAL. I.Sato, K.Itabashi and S.Sato.
Progr. theor. Phys., Vol. 14, No. 4, 303-16 (Oct., 1955).

The recoil correction to the adiabatic nuclear potential in the symmetrical pseudoscalar meson theory with pseudovector coupling is calculated up to the first order in the nucleon velocities by means of the F-S-T formalism (Abstr. 1504/1955) which is formulated by taking into account the normalization condition for the Tamm–Dancoff amplitude. Divergences which appear in the course of the calculations are subtracted by a sort of non-covariant renormalization procedure. Resultant correction consists of two parts, spin-orbit coupling part and velocity-independent part. The former is found to be of the correct sign and suitable magnitude as required by the theory of the nuclear shell model. A.

530.145

6376. THE SELF-ENERGY OF THE SCALAR NUCLEON. K.Mano.
Progr. theor. Phys., Vol. 14, No. 5, 435-56 (Nov., 1955).

The self-energy of the scalar nucleon, with the omission of the effects of the closed loops, interacting with the neutral scalar meson (with a vanishing rest mass) field for arbitrary strength of the coupling is computed by the Feynman's variational method extended to the path integrals. It is found that there is no lower limit of the energy eigenvalue even after the logarithmic divergence involved is cut off. However, there does exist a metastable state provided that μ', a measure of the coupling, is less than about 0.34. A.

530.145 : 548.

6377. RECOIL EFFECTS IN THE STRONG COUPLING THEORY. II. T.Toyoda.
Progr. theor. Phys., Vol. 14, No. 5, 473-81 (Nov., 1955).

For Pt I, see Abstr. 6289/1954. In order to take into account the angular correlation between two mesons emitted successively in the calculation of recoil effects of a nucleon, one assumes an admixture of S and P states for a trial functic of each meson in the centre-of-mass system. An application of the method to the polaron problem is done to estimate the correlation effect numerically, and it is shown that the effect is not so strong in the region of the usual polaron problem. Several approximation methods proposed by Gurari, Lee et al and Landau concerning the polaron self-energy are discussed from a general point of view. A

530.14

6378. THE RELATIVISTIC AND EXCHANGE CURRENT CORRECTIONS TO THE DEUTERON MAGNETIC MOMENT AND THE THERMAL n–p CAPTURE CROSS-SECTION. M.Sugawara.
Progr. theor. Phys., Vol. 14, No. 6, 535-50 (Dec., 1955).

Starting from the symmetrical ps meson theory, the rela tivistic and exchange current corrections to the thermal n–p capture cross-section and the deuteron magnetic moment hav been defined unambiguously and calculated using the T–D formalism up to the lowest order of the meson–nucleon coupling constant and the nucleon velocity. This work is a refinement and generalization of the previous paper (Abstr. 9438/1955) on the exchange current correction to the deuteron moment, the result of which is also obtained here. With respect to the relativistic corrections, quite a different method is use Numerical values of these corrections are then estimated by using the phenomenologically adjusted two nucleon wave functions with or without the hard core. The sum of these correc tions is shown to be about $+1\%$ of the capture cross-section and about -2% of the magnetic moment. The phenomenological thermal n–p capture cross-section is also estimated and is shown to agree with the experimental one within much larg experimental and theoretical ambiguities than the above correction. As the exchange current correction is reduced very much if the D-state probability is chosen to be smaller and there may be in addition some small positive non-additivity correction, the deuteron D-state probability is finally estimated as $3\pm1\%$ or so, the same value as was reported previously. A

530.145 : 539.18

6379. LOW ENERGY LIMITS OF PHOTON–NUCLEON AND PION–NUCLEON COLLISIONS. S.Hanawa, M.Namiki and S.Chiba.
Progr. theor. Phys., Vol. 14, No. 6, 551-79 (Dec., 1955).

Low energy limits of the photon–nucleon and the pion–nucleon collisions are investigated on the basis of the approximation which neglects higher order terms with respect to the pion–nucleon mass ratio but includes the radiative correction to an arbitrary order in the coupling constants. It is shown th near the threshold, all the radiative corrections to the processes, π + nucleon → nucleon + 2π and γ + nucleon → nucleon + 3π, can be concealed in the nucleon mass, the electric charge, the mesic charge and the Matthews' constant renorma ized in accordance with the conventional prescription, provide that the renormalized constant is of the same order of magnitude as or larger than the renormalized coupling constant for the pion–nucleon interaction. It is suggested that these processes may serve as the experimental determination of the Matthews' constant and the test of validity of the ps(ps) theory As preliminaries for these arguments, Thirring's and Kroll and Ruderman's theorems on the low energy Compton scattering and the threshold photomeson production are reviewed, taking account of those terms which have been omitted in the originals, and the effective charges are introduced for the

pion–nucleon scattering and the two-gamma decay of a neutral pion. It is noted that the results are unaffected by virtual processes caused by heavy mesons obeying the "even-odd' rule proposed by Pais. A.

530.145

6380. SCATTERING MATRIX IN THE HEISENBERG REPRESENTATION FOR A SYSTEM WITH BOUND STATES. A.Klein.
Progr. theor. Phys., Vol. 14, No. 6, 580-8 (Dec., 1955).

A definition is formulated of the scattering matrix for a closed physical system with bound states, which makes use only of the assumed observable properties of the system. A direct product space, X, is definied in which the ingredient factor space comprises the steady states — vacuum, one-particle, and bound states — of the physical system. It is argued that the boundary conditions for a scattering experiment are suitably expressed in terms of vectors in X and that these stand in unitary correspondence, U, to the Heisenberg states. Indeed, one defines two operators $U^{(\pm)}$ to express outgoing and ingoing wave boundary conditions, and the scattering matrix is constructed from these in the usual way. A suitable Yang–Feldman formalism is then developed in which the operators in the remote past and future also describe the bound states of the system. A representation of the framework thus constructed in terms of field operators for individual fields results in the well-known formulae for S-matrix elements in terms of covariant amplitudes. A.

530.145

6381. ON CERTAIN WAVE-PACKETS. J.Plebański.
Acta phys. Polon., Vol. 14, No. 4, 275-93 (1955).

Theorems concerning the properties of Kennard packets have been extended over all the solutions of the wave equation of a harmonic escillator. Generalizing these theorems to the quantum theory of fields, non-spreading wave packets with classical properties have been obtained. A.

530.145

6382. AN INTEGRATING APPARATUS FOR THE SCHRÖDINGER EQUATION. II. K.Antonowicz.
Acta phys. Polon., Vol. 14, No. 5, 385-93 (1955).

For Pt I see Abstr. 5207 (1954). Several improvements have been introduced in the integrating apparatus for the Schrödinger equation. The apparatus was calibrated by means of the Morse potential and its harmonic approximation. For verification purposes eigenvalues obtained by means of the apparatus agree within 1 per cent with the theoretical values. One of the eigenfunctions for Morse's potential was compared with a theoretical curve. A very good agreement between them was found. A.

530.145

6383. ON THE EIGENVALUE PROBLEM IN TERMS OF A COMPLETE SET OF THE CASIMIR OPERATORS. H.Narumi.
J. Phys. Soc. Japan, Vol. 11, No. 7, 786-92 (July, 1956).

The existence of the group of contact transformations, regarded as the so-called continuous Schrödinger group whose elements commute with Hamiltonian, is intimately related not only to the problem of degeneracy, as shown by Jauch and Hill, but also to the problem of quantization. In the present paper, it is shown that on the basis of representations of the Lie ring generated by the operators which have a certain definite correspondence with a set of independent integrals of the equations of motion in Newtonian mechanics, an energy eigenvalue problem can be constructed in terms of a complete set of the Casimir operators. It is further pointed out that this quantization procedure is, in spite of various restrictions, applicable to quantum-mechanical systems having the continuous Schrödinger group and then the degree of degeneracy in regard to the angular momentum can be obtained simultaneously. A.

530.145

6384. INTRODUCTION OF "TRUE OBSERVABLES" INTO THE QUANTUM FIELD EQUATIONS. P.G.Bergmann.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1177-85 (June, 1956).

The equations of quantum electrodynamics have been investigated with the unrestricted gauge group, without specializing to Lorentz or Coulomb gauge. Even before quantization, the theory is formulated in terms of "true observables" only. These are defined as dynamical variables generating canonical transformations leading from one permissible state to another; a permissible state, in turn, is a set of values of all canonical variables that obeys the gauge constraints. Similarly an observable in the quantized theory must be a Hermitian operator within the Hilbert space of permissible states; the latter are those obeying the gauge constraints. Transition to the true observables not only eliminates the longitudinal parts, of the vector potential and the scalar potential from the theory, but also the longitudinal components of the electric field strength. Likewise, the operators that create and annihilate charged particles are not themselves observables, but one can construct product combinations that are. Such (gauge-invariant) products involve the product of a creator by an annihilator at different space points, multiplied by a functional that depends on a line integral of the vector potential, the path of integration being any curve connecting the two space points. The Hamiltonian can in fact be written in terms of these observables only, and the infinite self-energy caused by non-transverse photons is eliminated automatically. A.

530.145

6385. VANISHING OF THE RENORMALIZED CHARGE IN ELECTRODYNAMICS AND IN MESON THEORY. I.Pomerančuk.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1186-203 (June, 1956).

The solutions of the quantum electrodynamics equations are discussed for the particles with spin $\frac{1}{2}$ obtained by various authors firstly with one "smearing out" parameter and subsequently with two parameters. It is proved that the solutions obtained are correct for all values of the non-renormalized electric charge e_1 ($e_1 \ll 1$ as well as $e_1 \gg 1$), and that both theories lead to the conclusion that the renormalized charge e turns out to be zero. It is then investigated if the same property holds also for the meson charge g in the pseudoscalar theory. Using the two-limits technique developed by Abrikosov and Halatnikov, the conclusion is reached that g also turns out to be zero. The problem of the vanishing of the renormalized meson charge is considered in detail examining the properties of the functions G, D and Γ at arbitrary g_1^2. The result of this analysis corresponds to the preceding conclusions, and confirms the vanishing of g. A.

530.145

6386. CONFORMAL INVARIANCE AND CONSERVATION LAWS FOR RELATIVISTIC WAVE EQUATIONS FOR ZERO REST MASS. J.A.McLennan, Jr.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1360-79 (June, 1956).

It is shown that the relativistic wave equations obtained by Gårding for particles of zero rest mass and arbitrary spin are invariant under the conformal transformations of space-time. Conservation laws corresponding to this invariance are obtained. They are formally identical with those found by Bessel-Hagen for the electromagnetic field, with the exception of those found for the scalar field. For this case, the conservation laws contain extra terms which arise from the fact that the trace of the energy-momentum tensor is not zero. A.

530.145

6387. APPLICATIONS OF SCATTERING THEORY TO QUANTUM STATISTICAL MECHANICS. K.M.Watson.
Phys. Rev., Vol. 103, No. 2, 489-98 (July 15, 1956).

A Laplace transform relation between the distribution function $\exp\{-\beta H\}$ in quantum statistical mechanics and the Green's function of the wave equation has been noted by Koppe.

This relationship may be extended to the stationary-state scattering equation. General properties of the transformation are discussed. Applications to the evaluation of the virial coefficients are considered. A further application of the perturbation methods of Brueckner and his collaborators is described. A.

530.145

6388. ELEMENTARY THEORY OF QUANTUM-MECHANICAL COLLECTIVE MOTION OF PARTICLES. I.
S.Tomonaga.
Progr. theor. Phys., Vol. 13, No. 5, 467-81 (May, 1955).

An elementary theory of quantum-mechanical collective motion of many-particle systems is developed. The fundamental idea is illustrated by taking an example of surface oscillation of an incompressible system of particles. The essential point of the theory is, roughly speaking, the neglect of $1/\sqrt{N}$ against unity, N being the number of particles of the system. The method is a natural generalization of separation of translational motion from the internal relative motion by the use of centre of mass coordinates. A description in terms of field concept is briefly discussed. A.

530.145

6389. ELEMENTARY THEORY OF QUANTUM-MECHANICAL COLLECTIVE MOTION OF PARTICLES. II.
S.Tomonaga.
Progr. theor. Phys., Vol. 13, No. 5, 482-96 (May, 1955).

The method illustrated in Pt 1 referring to the surface oscillation is applied to longitudinal oscillations of particles mutually interacting through Coulomb or non-Coulomb forces. Comparison with Bohm's and Bloch's theories is made. It is found that precisely the same results are obtained. A.

530.145

6390. GRAPHICAL METHOD OF DETERMINING PHASE SHIFT. W.Paskievici and P.Pluvinage.
C.R. Acad. Sci. (Paris), Vol. 242, No. 21, 2550-2 (May 23, 1956). In French.

The method is outlined for the case of an S-wave with the restrictions, (a) the potential V(r) is non-singular at the origin, and (b) the collision energy is greater than V(r) for all r. The potential curve, curtailed at a suitable value of r, is divided into N segments in which average values of potential are taken; using these in an approximate wave equation for each segment, a new graph of wave function u against $k^{-1}u'$ is drawn, from which the phase shift may be read as the angle between two vectors. The method was checked for a soluble problem involving an exponential well, the observed error being a few percent. N.M.King

530.145

6391. ON THE RENORMALIZATION OF HEISENBERG TREATMENT. I.Watanabe.
Progr. theor. Phys., Vol. 14, No. 2, 151-65 (Aug., 1955).

Dyson's renormalization method has been applied to the simultaneous integral equations of the vacuum expectation values of Heisenberg operators. The renormalized integral equations will always be free from the well-known divergence difficulties, not only in the perturbation expansions but for any other approximations. The same method is also applicable to the bound state equations. Further, for the real nucleons which are surrounded by the cloud of virtual mesons, expressions are given for the S-matrix, the expectation values and the normalized wave functions. A.

530.145

6392. THE ENERGY LEVELS AND TRANSITION PROBABILITIES FOR A BOUNDED LINEAR HARMONIC OSCILLATOR. J.S.Baijal and K.K.Singh.
Progr. theor. Phys., Vol. 14, No. 3, 214-24 (Sept., 1955).

The first five energy levels and the oscillator strengths for transitions involving the first three states have been numerically computed for a bounded linear harmonic oscillator for various values of the boundary parameter. It is found that for $l > 3l_0$, where l is the length of the box within which the oscillator is confined and l_0 is the classical amplitude of the oscillator when it has energy $h\nu$, the bounded oscillator behaves more or less like a free oscillator (in the first few energy levels), while for $l < l_0$ it has properties closely approaching those of a free particle enclosed in a box. A

530.14

6393. RELATIVISTIC WAVE EQUATIONS WITH MAXIMUM SPIN TWO. T.Tsuneto, T.Hirosige and I.Fujiwara.
Progr. theor. Phys., Vol. 14, No. 4, 267-82 (Oct., 1955).

The relativistic wave equations in the canonical form with a maximum spin of 2 are analysed the assumption that each matrix involved is a direct sum of two mutually commutable Duffin–Kemmer operators. Five independent sets of tensor equations are established by algebraic procedures and each set of equations is further reduced to several simple sets of equations, each corresponding to definite values of mass and spin. Physical consequences of the theory are discussed. Tw mass values are possible, one being twice as large as the other, and the possible values of spin are 2, 1 and 0. The fiel with spin 2 is of the Fierz–Pauli type. Among the fields with spin 1 some are governed by equations different from the usu ones of the vector meson. The total energy of the whole field is not definitely positive, the contributions of the parts with lower and higher mass values being positive and negative respectively. A

530.14

6394. SCHRÖDINGER'S EQUATION IN TWO DIMENSIONS AND THE REPRESENTATIONS OF A GROUP OF DISPLACEMENTS OF A PLANE. É.L.Konstantinova and G.A.Sokolik.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 430-1 (1956). In Russian.

It is shown that the irreducible representations of the Euclidean group (congruent translations and rotations of a plane) are related to Bessel functions in a way similar to the representations of rotations to spherical harmonics. The authors assert that this result is of significance for the quantum mechanics of a particle in two dimensions.
R.Eisenschitz

530.14

6395. LINEARIZATION OF THE HARTREE EQUATIONS. P.S.Zýryanov and V.M.Eleonskiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 592 (1956). In Russian.

A type of phase-amplitude substitution is made to bring the Hartree equations into a form convenient for considering plasma oscillations. Taking as zero-order the solution for a uniform particle distribution, a perturbation calculation for small density fluctuations is outlined. G.E.Brown

530.16

6396. DIFFUSION OF CHARGED PARTICLES ACROSS A MAGNETIC FIELD. C.L.Longmire and M.N.Rosenbluth.
Phys. Rev., Vol. 103, No. 3, 507-10 (Aug. 1, 1956).

This is studied treating collision-induced steps of the guiding centres as a random walk process. Particular attention is paid to the vanishing of the first-order flux due to like-particle collisions. A.

530.162 : 530.145

6397. A NEW APPROACH TO QUANTUM-STATISTICAL MECHANICS. T.Matsubara.
Progr. theor. Phys., Vol. 14, No. 4, 351-78 (Oct., 1955).

A new method of calculating the grand partition function of many-body system is developed, adopting extensively the techniques of calculus in quantum field theory. It is shown tha the grand partition function, which is a trace of the density matrix expressed in terms of field operators, can be evaluate

in a way almost parallel with the evaluation of the vacuum expectation value of the S-matrix in quantum field theory, provided that appropriate modifications in notation and definitions are made. As an example, the method is applied to electron–phonon system. Further, based on this new formalism, various non-perturbational methods are discussed. A.

530.162 : 533.7

6398. THE RELATIVISTIC KINETIC EQUATION. S.T.Belyaev and G.I.Budker.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 6, 807-10 (1956). In Russian.

It is shown that the usual distribution functions in single-particle phase space are Lorentz-invariant. A relativistic generalization of the collision equation of Maxwell and Boltzmann is discussed and applied to a gas consisting of free electrons. R.Eisenschitz

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.25 : 535.55

6399. THE PHOTOGRAPHIC REPRESENTATION OF UNIFORM SHEAR BEYOND THE FIRST ISOCHROMATIC ORDER IN PHOTOELASTICITY EXPERIMENTS. H.Schwieger and G.Haberland.
Z. angew. Phys., Vol. 8, No. 7, 350-5 (1956). In German.

A procedure is described, using photo-elastic models in which no isochromatics are observed, by which the optical phase difference can be entirely determined from a photograph. The method is illustrated by a Plexiglass model and the necessary procedure is described. H.G.Jerrard

531.259

6400. THERMAL STRESSES IN THE COOLING OF A SPHERE. E.Melan.
Acta phys. Austriaca, Vol. 10, No. 1-2, 81-6 (1956). In German.

From the equations $[\nabla^2 T] = (1/a)(\partial T/\partial t)$ and $\nabla^2\Psi = E\alpha T/(4G-E)$ where T, t, a, Ψ, α, G and E denote the temperature, time, diffusivity, thermo-elastic displacement, expansion coefficient, shear modulus and Young's modulus respectively, and the stress system for T = O, the solution is obtained for the stress distribution in a sphere, radius c, which is heated to T_0 and then immersed in a fluid at T_1. Graphs of the radial and tangential stresses as a function of the radius with the time as parameter are given. The maximum tangential stress occurs at the surface at t = O, and is equal to $\frac{1}{4}K = E\alpha T_0/(2-E/2G)$ and the maximum radial stress at $t = 0.0583\ c^2/a$ is equal to $-0.0965\,K$. S.Weintroub

531.566

6401. PHOTOELECTRIC ANGULAR ERROR SENSORS. R.A.Nidey and D.S.Stacey.
Rev. sci. Instrum., Vol. 27, No. 4, 216-18 (April, 1956).

A technique is described for the accurate measurement of angular errors using photoelectric detectors. Utilizing two types of robust, compact cartridges, a wide range of characteristic curves may be synthesized. Examples of various systems are shown, including one for a high-accuracy servo. The latter has a coverage of 360 degrees, a null accuracy of one minute and is in current use in Aerobee Rockets. A.

531.57

6402. GUIDE TO THE SUCCESSFUL PROPULSION OF A SOLID OBJECT BY AN EXPLOSIVE CHARGE. J.S.Rinehart.
J. appl. Phys., Vol. 26, No. 12, 1518 (Dec., 1955).

Attention is directed to a general principle controlling the propulsion of a missile at high velocity by an explosive charge (Abstr. 9449/1955). The principle is based on the fact that if the missile is to remain intact after acceleration, all its parts must be accelerated to the same velocity. The mathematical expression embodying this requirement, is $\int_0^\infty F_S(t)dt/m_S =$ a const., $F_S(t)$ denoting the force acting on the elemental area dS at time t and m_S the mass lying below dS.

J.S.G.Thomas

MECHANICAL MEASUREMENTS 531.7

531.717.3 : 621.317.79

6403. A MECHANICAL-ELECTRICAL TRANSDUCER OF SIMPLE DESIGN. M.Manzotti.
J. sci. Instrum., Vol. 33, No. 8, 314-15 (Aug., 1956).

A probe electrode plunged into a current field experiences a potential which is a function of its position in the field; when it is moved, the variation of potential is also a function of the displacement. This principle makes possible the design of mechanical-electrical transducers of simple construction and easy assemblage. An application to pressure recording is here described. The sensitivity (5 cm of water per full deflection) and speed of response (no distortion for variations of pressure up to 220 cm of water per second) can, if necessary, be easily improved. A.

531.768

6404. TRANSIT-TIME ACCELEROMETER. L.M.Jones.
Rev. sci. Instrum., Vol. 27, No. 6, 374-7 (June, 1956).

An omnidirectional transit-time accelerometer, developed for measuring the drag acceleration of spheres dropped from rockets, is described. The ambient density and temperature of air may be calculated from the drag acceleration. In the device, a bobbin is periodically caged and released within a cavity. The time for the bobbin to traverse the distance to the cavity, which distance is the same in any direction, is telemetered and measured. The accelerometer range is about 5×10^{-3} to 5 g. Systematic errors and standard deviations over the range are about 1%. The accelerometer was used successfully in a rocket flight in which the drag acceleration of a 7 in. dia. sphere was measured. A.

531.787.6

6405. MICROMANOMETER OF HIGH SENSITIVITY. S.Lynn, W.H.Corcoran and B.H.Sage.
Rev. sci. Instrum., Vol. 27, No. 6, 368-9 (June, 1956).

A sensitive micromanometer based on the observation of the movement of a bubble of air in a precision-bore, horizontal capillary tube was constructed. The sensitivity was varied by connecting different-sized chambers which had nominal diameters of 1, 2 and 3 in. The sensitivity could be varied between 2×10^{-5} in. and 2×10^{-6} in. of manometer fluid. A.

MECHANICS OF FLUIDS 532

532.13/.14 : 541.133

6406. SIMULTANEOUS MEASUREMENTS OF DENSITY, VISCOSITY, AND ELECTRIC CONDUCTIVITY OF MELTS. J.D.Mackenzie.
Rev. sci. Instrum., Vol. 27, No. 5, 297-9 (May, 1956).

An apparatus is described for the simultaneous measurements of density, viscosity, and electric conductivity of ionic liquids at high temperatures. Density is simply measured by the suspension of a platinum bob in the melt contained in a platinum crucible situated inside a vertical tube furnace. The bob is suspended by a platinum wire attached to one arm of an analytical balance. Upward or downward motion of the bob in the melt is produced by changing the weights on one pan of the balance. The velocity of the bob, directly dependent on the

viscosity of the melt, is calibrated against a standard liquid from 10 to 10 000 poise. By using the suspension and the crucible as the two electrodes, the apparatus becomes a conductance cell. The corrections in density measurements due to surface tension are eliminated by the use of two bobs of different dimensions but similar suspension wires. This furnishes not only duplicate viscosity results but also two cell-constants for electric conductance. Vacuum fusion is possible in the same apparatus. A.

532.51

6407. THE SIMILITUDE OF [FLUID] VELOCITY FIELDS AND SHORT WAKES IN ACCELERATED REGIMES. G.Batailler.
C.R. Acad. Sci. (Paris), Vol. 242, No. 22, 2619-21 (May 28, 1956). In French.

Similitude conditions, relating to the phenomena of fluid flow, studied experimentally by chromophotography in a previous paper, (Abstr. 3521/1956), are discussed mathematically. Equations are derived enabling stresses in the flow to be determined from the flow. The wake behind a plane immersed in the fluid flow is discussed in terms of the velocity field and the distance of the point of zero flow behind the plane; a linear graph, representing the experimental results, for different values of the fluid acceleration and size of plane, is given. J.S.G.Thomas

532.51 : 530.162

6408. CORRELATION TENSORS IN STATISTICAL HYDRODYNAMICS IN POROUS MEDIA. A.E.Scheidegger.
Canad. J. Phys., Vol. 34, No. 7, 692-8 (July, 1956).

The author's statistical theory of flow through porous media, based upon an extremely simple model in which the pressure fluctuations are neglected, has been criticized because velocity correlation tensors had not been introduced as dynamical variables. It is shown in the present paper that the introduction of such variables is not useful in the author's theory. This is due to the particularly simple nature of the model employed and does not imply that the use of correlation tensors may not lead to something useful in other conceivable statistical theories. A.

532.517.2

6409. FURTHER INVESTIGATION OF LAMINAR FLOW IN CHANNELS WITH POROUS WALLS. S.W.Yuan.
J. appl. Phys., Vol. 27, No. 3, 267-9 (March, 1956).

The problem of two-dimensional steady-state laminar flow in channels with porous walls has been extended to the case of moderate to high suction or injection velocity at the walls. An exact solution of the Navier–Stokes equations, reduced to a third-order nonlinear differential equation with appropriate boundary conditions, is obtained. The velocity components, the pressure and the coefficient of wall friction are expressed as functions of velocity through the porous walls, the average axial velocity of Poiseuille's flow, the coordinates and dimensions of the channel, and the physical properties of the fluid. A.

532.517.2

6410. THE FORCES ACTING ON TWO CIRCULAR CYLINDERS OF ARBITRARY RADII PLACED IN A UNIFORM STREAM AT LOW VALUES OF REYNOLDS NUMBER. H.Fujikawa.
J. Phys. Soc. Japan, Vol. 11, No. 6, 690-701 (June, 1956).

The steady slow motion of a viscous fluid past two parallel circular cylinders C_1, C_2 of arbitrary radii is discussed on the basis of Oseen's linearized equations of motion, confined to the case when their axes are perpendicular to a uniform flow. The forces acting on the cylinder C_1 are calculated to the first approximation. By performing detailed numerical calculations, a discussion is made on the manner in which the forces acting on the cylinder C_1 are modified by the presence of the other cylinder C_2. It is thus found that, as the radius of the cylinder C_2 increases, the drag on the cylinder C_1 decreases, while th lift increases. It is also found that the cylinder C_1 experience smaller drag when the two cylinders are in tandem orientatio than when they are placed side by side in a uniform stream. When the cylinder C_1 is situated behind the cylinder C_2, it experiences smaller drag than when it is situated in front of A

532.52

6411. THE ACCELERATED MOTION OF DROPLETS AND BUBBLES. T.Pearcey and G.W.Hill.
Austral. J. Phys., Vol. 9, No. 1, 19-30 (March, 1956).

The drag force acting upon small particles such as droplets and bubbles, moving through a viscous medium, depends upon the rate of change of the state of motion of the medium and upon the diffusion of vorticity from the surface of the particle. For accelerated particles the drag force changes with time and depends upon all previous accelerations. The equation of motion of a particle takes the form of an integro-differential equation, which has been solved numerically in the case of deceleration to rest from uniform motion with no impressed body forces. In any experiments designed according to the principles of dynamical similarity, the ratios of viscosities and densities of the medium and the particle must be maintained constant in the scale transformations involved. A

532.52 : 533.6.011

6412. APPARATUS AND TECHNIQUES FOR THE APPLICATION OF A WATER FLOW SYSTEM TO THE STUDY OF AERODYNAMIC SYSTEMS. E.F.Winter and J.H.Deterding.
Brit. J. appl. Phys., Vol. 7, No. 7, 247-60 (July, 1956).

The study of fluid flow in such gaseous systems as combustion chambers and furnaces is of value in the design and subsequent operation of the equipment. Useful information ma be obtained from flow visualization in these systems under co stant density conditions, even though in practice considerable density changes occur. Hydraulic models are then found to have distinct advantages over air models. Apparatus has been developed by means of which the flow of water may be studied in transparent models of the simulated air systems. The flow is rendered visible by plastic tracers, of similar density to water, which are illuminated by continuous filament lamps, long-duration electronic flash lamps or vapour discharge lam according to the information required. Selected parts of the flow field may be observed by means of a narrow, flat beam o light directed through the appropriate section of the model. Semi-quantitative records of flow components may be derived from photographs obtained with the flash illumination. Individual tracers may be observed by selective illumination involving an ultraviolet light source and fluorescent tracers. The subject is treated from a wholly practical point of view. Deta of the apparatus and techniques are given, with examples of some of the types of information obtainable, and the elementa requirements for similarity with aerodynamic systems are stated. A.

532.52

6413. EXPERIMENTAL TEST OF THE THEORY OF PENETRATION BY METALLIC JETS. R.J.Eichelberger.
J. appl. Phys., Vol. 27, No. 1, 63-8 (Jan., 1956).

Experimental measurements of jet velocity and of penetration velocity as functions of depth of penetration are described for lined cavity charges fired into several types of tar get material and under a variety of experimental conditions. The results show that the hydrodynamic theory of penetration of Pugh and of Hill, Mott, and Pack describes very accurate the early stages of the penetration process. Strength of the target becomes an appreciable factor in the later stages, how ever. A simple modification of the theory is described which appears to account adequately for these strength effects. Som alterations in ideas concerning the mechanism of penetration by the jet after fracture are also described. A

532.527

414. SOMMERFELD'S DIFFERENTIAL EQUATION ELATING TO HYDRODYNAMIC STABILITY. .S.Mitrinovitch.
.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2287-9 (May 7, 956). In French.

A solution of Sommerfeld's differential equation relating o hydrodynamical stability in turbulent flow, is derived in he form of an infinite series of functions by comparison of he equation with the second-order linear differential equation tudied by Darboux (1915), Drach (1919) et al. The solution s of importance in connection with Tollmien's generalization f researches of Misès, Prandtl and others relating to turbuent flow (Zeitschrift für angewandte Mathematik und Mechanik, ol. 25-27, 33-50, 1947). J.S.G.Thomas

532.582.5

415. COMMENTS ON LIMITING PRESSURE ON HYDROOILS. E.V.Laitone.
. appl. Phys., Vol. 26, No. 12, 1519-20 (Dec., 1955).

The author has previously shown that if hydrostatic flow onditions are present on the upper surface of a thin hydrofoil, t small angles of attack, as it approaches the free water urface, then there is a limiting maximum surface velocity etermined by the maximum water depth recovery that can e produced by a hydraulic jump (Abstr. 7158/1954). Recent xperimental and theoretical work by Parkin, Perry and Wu Hydrodynamics Laboratory Report, California Inst. of echnology, to be published) has shown that at high Froude umbers, (M_∞) the hydraulic jump and accompanying velocity imitation do not occur even when $F (= gh^{1/2} > 1) < 1$. Their xperimental data show that the velocity limitation is applicable when $M_\infty \leq 1$, but is not valid when $M_\infty > 3^{1/2}$. Illustrative photographic experimental results are given. J.S.G.Thomas

532.59

3416. THE PROBLEM OF PROPER VALUES ASSOCIATED WITH CAUCHY—POISSON WAVES. A.Huleux.
C. R. Acad. Sci. (Paris), Vol. 242, No. 19, 2289-92 (May 7, 1956). In French.

Properties of two-dimensional Cauchy—Poisson waves, produced either by percussion or by initial elevation of the surface of a deep still liquid, enabling the phenomenon to be studied mathematically by analogy with actual oscillations, are discussed briefly. J.S.G.Thomas

532.595

6417. STABILITY OF OSCILLATIONS OF SUPERPOSED FLUIDS. C.-M.Tchen.
J. appl. Phys., Vol. 27, No. 7, 760-7 (July, 1956).

The Stokes—Taylor instability of the interface of two superposed fluids is studied. The two uniform layers of heavy fluids are of different densities and viscosities and are incompressible. Surface tension and gravity are taken into consideration. The main problem considered is the role of viscosity on the modes of decay and growth of waves and the finding of an analytical solution more generally valid than those in existing approximate theories. This viscous theory is based on an approximation by interpolation exact in three regions of wave numbers (intermediate and two extreme regions). The extreme regions, being most important from the practical point of view and serving as a foundation of the theory, are studied in detail up to the fourth order. Results are illustrated graphically and show good agreement with numerical solutions of the complete equation. For comparison, curves are also drawn according to existing theories and show discrepancies in the maximum rate of growth and decay from 12% to more than 100%. A.

CAPILLARITY 532.6

532.61.08

6418. A "NULL" METHOD OF MEASURING SURFACE TENSION, WITH A TORSION BALANCE. S.Venkataraman.
Indian J. Phys., Vol. 29, No. 11, 522-6 (Nov., 1955).

Describes a "null" method for the determination of the surface tension of a liquid by the use of a torsion balance. An expression is deduced for the surface tension of a liquid, when the pull due to the surface tension acting along the perimeter of a thin glass plate (usually a microscopic cover glass slip) is balanced by the upthrust of the liquid on the partially immersed plate. The results obtained with a few liquids are reported and they agree with the values recorded in the International Critical Tables. This method yields more consistent results than any of the routine methods usually used for the measurement of surface tension. A.

532.612.4

6419. SURFACE TENSION OF LIQUIDS: A NOTE ON A PAPER BY SIMONS AND WILSON. D.J.Simkin.
J. chem. Phys., Vol. 24, No. 3, 616 (March, 1956).

See Abstr. 5246 (1955). A modified formula for the ratio of surface tension at any temperature to that at boiling point is suggested. It is further stated that T_b/T_c cannot be assumed constant and it is shown how values of T_c can be obtained for some fluorocarbons. T.C.Toye

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

6420. ON THE STRUCTURE OF SIMPLE LIQUIDS. A.E.Glauberman and V.P.Tsvetkov.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 4, 623-5 (1956). In Russian.

A procedure for determining the temperature dependence of the coefficient of structure diffusion, which enters into the radial distribution function proposed by Glauberman for simple liquids (Abstr. 7078/1952), is outlined. Theoretical and experimental data (based on X-ray scatter measurements) are presented for lead. A.Gelbtuch

532.783

6421. LATTICE THEORY OF LIQUID STATE. I.Shimose.
J. Phys. Soc. Japan, Vol. 11, No. 6, 615-19 (June, 1956).

The lattice theory of the liquid state is developed by using the cell model of the lattice type with interstitial sublattices. The free energy, the pressure, and the quantities at the critical point are calculated by a quasi-chemical approximation. The agreement of the calculated values of τ_c, v_c/v_0 and $p_c v_0/\epsilon$ with their observed values is considerably better compared with the calculated values for the cell model of the lattice type with no sublattices. A.

MECHANICS OF GASES 533

533.15 : 539.132

6422. HIGHER APPROXIMATIONS TO DIFFUSION COEFFICIENTS AND DETERMINATION OF FORCE CONSTANTS. S.C.Saxena.
Indian J. Phys., Vol. 29, No. 10, 453-60 (Oct., 1955).

Making use of collision integrals previously calculated (Abstr. 9476/1955) along with those reported by Hirschfelder,

PA

Bird and Spotz, the correction factor for the third approximation to the tracer diffusion has been calculated by utilizing the expressions developed by Mason on the scheme adopted by Chapman and Cowling. The third approximation to the coefficient of interdiffusion and the second approximation to the thermal diffusion ratio have also been calculated for the particular case of A–He mixture. The effect of these higher approximations on the determination of the force parameter from the temperature dependence of the transport coefficients have been critically examined. It has been shown that these higher approximations do not vitiate the method developed by Srivastava and Madan elsewhere for calculating the force constants from the thermal diffusion data for unlike molecules.

A.

533.16

6423. THE SECOND VISCOSITY OF MONATOMIC GASES. I.M.Khalatnikov.
Zh. éksper. teor. Fiz., Vol. 29, No. 2(8), 253-4 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 169-70 (Jan., 1956).

It is shown that the second viscosity is zero for a monatomic gas obeying quantum statistics, provided that the energy of a particle is proportional to a power of the momentum.

E.H.Sondheimer

533.275

6424. AN APPARATUS FOR PRODUCING AIR OF CONTROLLED RELATIVE HUMIDITY FOR HYGROMETER CALIBRATION AND TESTING. L.A.Cram.
J. sci. Instrum., Vol. 33, No. 7, 273-6 (July, 1956).

Wet and dry air streams are mixed in variable proportions to produce air between 30 and 85% r.h. This humidity is stabilized by automatic control using an electrolytic hygrometer. Calibrations reproducible to better than 0.2% r.h. can be carried out quite quickly.

A.

533.275

6425. MEASUREMENT OF AIR HUMIDITY WITH THE AID OF SEMICONDUCTING THERMOCOUPLES. N.V.Kolomoets, M.S.Starnzas, L.S.Stil'bans and N.P.Fateev.
Zh. tekh. Fiz., Vol. 26, No. 3, 686-92 (1956). In Russian.

A dew-point type hygrometer is described. Cooling of the polished surface by 25 to 30°C, based on the Peltier effect, is obtained by means of semiconducting thermoelements of unspecified material. Details of auxiliary apparatus and circuitry are given.

533.5 : 531.788.7

6426. SIMPLIFIED IONIZATION GAUGE CIRCUIT WITH LOGARITHMIC PRESSURE SCALE. P.Hariharan and M.S.Bhalla.
Rev. sci. Instrum., Vol. 27, No. 7, 448-9 (July, 1956).

The control circuit described utilizes a logarithmic difference amplifier to measure the ratio of the positive ion current to the electron current drawn by the gauge. This eliminates the necessity of stabilizing the electron current within close limits and permits direct readings of pressures ranging from 10^{-3} to 10^{-7} mm of mercury on a single logarithmic scale.

A.

533.59 : 537.534.3

6427. THE OMEGATRON AS A LEAK DETECTOR. R.L.Bell.
J. sci. Instrum., Vol. 33, No. 7, 269-72 (July, 1956).

The omegatron, a radio-frequency mass spectrometer, has been applied to the detection of very small leaks using the helium probe technique. Although intrinsically of similar sensitivity to the conventional magnetic sector mass spectrometer, its effective sensitivity can be very much increased by reducing the speed at which the leak and leak detector combination is pumped, an operation which is not feasible with the usual mass spectrometer. By this means leaks of 10^{-11} l.mb/sec are readily found. The limiting sensitivity appears to lie in the 10^{-14} l.mb/sec region. A simple omegatron constructed for leak detection is described, and precautions to be taken the use of helium mentioned.

533

6428. ELECTRICAL CONTACT FOR HIGH VACUUM SYSTEMS. R.Gomer.
Rev. sci. Instrum., Vol. 27, No. 7, 544 (July, 1956).

533.6.011

6429. THE FLOW PAST A FLAT PLATE ACCOMPANIED WITH AN UNSYMMETRIC DEAD AIR AT MACH NUMBER 1 T.Sakurai.
J. Phys. Soc. Japan, Vol. 11, No. 6, 710-20 (June, 1956).

The flow past a flat plate with a small angle of attack a Mach number 1 is investigated, using Imai's WKB method. Comparing the results with those of Guderley and of Truitt, is shown that they agree fairly well with each other. It may concluded that the dead air model is useful for the study of t transonic flow.

533.6.011.31 : 532.5

IMPINGEMENT OF PARTICLES ON A TRANSVERSE CYLINDER. See Abstr. 5718

533.6.01

6430. INTEGRATION OF A SYSTEM OF LAGRANGE EQUATIONS IN THE PROBLEM OF SHORT-DURATION IM PACT IN A COLD GAS. V.B.Adamskiĭ.
Akust. Zh., Vol. 2, No. 1, 3-9 (1956). In Russian.

The system of equations is derived and studied in gene form for any adiabatic parameter γ. The power index, upo which the Lagrangian solution depends, may be found by numerical computation from a particular point to that of the initial conditions. A value is deduced for the index and gra obtained of the physical quantities in Euler and Lagrange coordinates by numerical computation for a diatomic gas ($\gamma = \frac{7}{5}$).

C.R.S.Mande

533.6.01

6431. THE MOTION OF A GAS UNDER THE ACTION OF MOMENTARY PRESSURE (IMPACT). Ya.B.Zel'dovich.
Akust. Zh., Vol. 2, No. 1, 28-38 (1956). In Russian.

The paper considers the propagation of a plane shock w and the motion behind the wave front arising in the gas duri the action of a strong, momentary, external pressure. The law of attenuation of the wave and the distribution of pressu density and velocity which must occur after the action of th pressure ceases, are found to be asymptotic over a time la in comparison with the duration of the external pressure. T solution shows an exponential dependence upon wave amplitu time and distance traversed by the wave. The author also examines difficulties with the equations of conservation of momentum and energy in the asymptotic solution and also th problem of practical realization of such motion.

C.R.S.Mande

533.6.011

6432. ON THE VORTICES PRODUCED IN SHOCK DIFFR TION. L.N.Howard and D.L.Matthews.
J. appl. Phys., Vol. 27, No. 3, 223-31 (March, 1956).

The vortex produced by a weak shock passing over a 5° vertical wedge has been studied experimentally and theoreti ally. The theory applies to any vortex in isentropic flow wh has a certain rotational symmetry, and which expands unifo ly in time (pseudo-stationary flow), without consideration of how the vortex was formed. By fitting essentially one parameter of the theory to the interferometrically observed den good agreement is obtained over the region of the vortex, ex cept at the very centre. The rate of growth of the vortex as function of free-stream Mach number has been found in agre ment with that predicted by [N.Rott (private communication)

n the basis of another theory. The photographs show a well-leveloped spiral slip stream winding off the corner which con-ains small secondary eddies whose average angular spacing, neasured from the vortex centre, appears to be roughly inde-)endent of shock strength and time. A.

MOLECULAR THEORY OF GASES 533.7

533.7 : 530.162

6433. PHASE TRANSITION OF HUSIMI-TEMPERLEY MODEL OF IMPERFECT GAS. S.Katsura.
Progr. theor. Phys., Vol. 13, No. 6, 571-86 (June, 1955).

The author considers the Husimi-Temperley model of the imperfect gas, whose each particle interacts with all the other particles. It is shown in this model that the analytic singular point z_S of Mayer series by cluster integrals is not the condensation point, and that the isotherm obtained from the canonical partition function has a metastable part, while that from the grand partition function has a horizontal part. It is also shown that this model does not go beyond the scheme of the theories of Mayer, Yang-Lee, and Ikeda. Some general remarks are made in connection with this model. A.

533.7 : 530.162

6434. THE STATISTICAL MECHANICAL ASPECT OF H-THEOREM. E.Teramoto and C.Suzuki.
Progr. theor. Phys., Vol. 14, No. 5, 411-22 (Nov., 1955).

A simple model of diffusion is investigated without such an assumption as the "Stosszahlansatz". A one-dimensional box which is divided into two parts by a wall at its middle is considered. In the left half of the box, at time t = 0, there are N small particles which collide with each other elastically. If the wall is removed at t = 0 these particles diffuse into the right half of the box and the number of particles n(t) in the left half of the box changes, decreases generally, as a function of time t. The behaviour of functions n(t) in this process, which have widely different properties according to the choice of initial conditions or mechanical trajectories in phase space, are examined and it is shown that if the number of particles is sufficiently large almost all the trajectories show the mean properties of n(t) which is characterized by the irreversibility. The results obtained are compared with those calculated by the usual method in which the "Stosszahlansatz" is used as a basic assumption. Finally a statistical mechanical interpretation of H-theorem, which seems to be a generalization of the results obtained, is presented. A.

VIBRATIONS. ACOUSTICS 534

534.01 : 621-52

6435. CONDITIONS FOR APERIODICITY IN LINEAR SYSTEMS. R.H.Macmillan; A.T.Fuller.
Brit. J appl. Phys., Vol. 6, No. 12, 450, 450-1 (Dec., 1955).

See Abstr. 6814 (1955). A method, analogous to the Routh tabulation procedure, is outlined for finding if a system is both aperiodic and stable. This method, outlined by the second author, is in response to a question put by the first author. The result is that half of the determinantal inequalities (based on the Routh—Hurwitz determinants) are in practice superfluous, and may be replaced by the much simpler condition that the coefficients be all positive. The conjecture is raised as to whether half of the usual inequalities for stability alone are similarly superfluous. L.S.Goddard

534.112

6436. STRING UNDER THE ACTION OF A PLANE RUBBER WHEEL. H.G.Mane.
Indian J. Phys., Vol. 29, No. 12, 573-6 (Dec., 1955).

A string of cat-gut is excited by a plane rubber wheel — a wheel having no teeth along the circumference — and the vibrations of the string are recorded by using a vibroscope. It is observed that the vibrations of any point of the string consist of a two-step zig-zag curve and that they are identical with those of the bow. A.

534.121

6437. ON THE TRANSVERSE VIBRATION OF AN ELLIPTIC PLATE WITH CLAMPED EDGE. Y.Shibaoka.
J. Phys. Soc. Japan, Vol. 11, No. 7, 797-803 (July, 1956).

The transverse vibration of a uniform thin elliptic plate with clamped edge is solved in an exact manner by the use of Mathieu functions and modified Mathieu function. The relationship between the frequency of the fundamental mode of vibration and the eccentricity of the elliptic plate is shown graphically. Also, an approximate formula for the said relationship is derived correct to the fourth power of the eccentricity, which may be adequately used in cases when the eccentricity is not so large. A.

534.131

6438. FREE VIBRATIONS OF ISOTROPIC CUBES AND NEARLY CUBIC PARALLELEPIPEDS. H.Ekstein and T.Schiffman.
J. appl. Phys., Vol. 27, No. 4, 405-13 (April, 1956).

Free vibrations of isotropic cubes and nearly cubic parallelepipeds are derived by a modification of the Ritz method. The trial functions are chosen to be similar to actual modes, but simple enough to be manageable. The semidirect method of variational calculus is used to obtain some of them, others are simple solutions of somewhat different elastic problems. The resultant secular determinant of 15th degree is reduced (factored) by the use of group theory, so that the frequency equation can be solved analytically. The modes are classified according to symmetry properties. Some unexpected degeneracies are found which are not predicted by group theory. A.

534.213.4

6439. ON SOUND PROPAGATION IN LIQUID-FILLED RIGID TUBES. H.W.Helberg.
Acustica, Vol. 5, No. 5, 267-8 (1955). In German.

The absorption and velocity of sound waves in rigid tubes filled with liquid are calculated for the transition region between the Rayleigh and the Helmholtz approximations. A.

534.22/23

6440. THE ACOUSTIC PROPERTIES OF A THIN-LAYERED MEDIUM. S.M.Rytov.
Akust. Zh., Vol. 2, No. 1, 71-83 (1956). In Russian.

A medium which consists of alternating layers of two isotropic substances behaves, for the case where the wave-field alters only slightly within the thickness of a separate layer, as if it were homogeneous but anisotropic. The anisotropy corresponds with that of a crystal of hexagonal symmetry. Expressions are obtained for the effective elastic constants of the crystal as a function of the parameters of both substances and the layer thickness. The cases are examined of alternate layers of two solid substances and of one solid and one liquid substance. Since their properties can be varied (anisotropy of velocities of propagation and absorption both for compression and displacement waves) layered materials possess a practical interest for sound and vibration insulators.
C.R.S.Manders

534.22/.23

6441. PROPAGATION OF SOUND IN FIVE MONATOMIC GASES. M.Greenspan.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 644-8 (July, 1956).

The speed and attenuation of sound at 11 Mc/s were measured in He, Ne, A, Kr and Xe at various pressures between atmospheric and a few mm Hg, and the results were compared with existing theories. A.

534.22/.23 : 539.374

6442. SENSITIVITY OF ULTRASONIC ATTENUATION AND VELOCITY CHANGES TO PLASTIC DEFORMATION AND RECOVERY IN ALUMINUM. A.Hikata, R.Truell, A.Granato, B.Chick and K.Lücke.
J. appl. Phys., Vol. 27, No. 4, 396-405 (April, 1956).

Measurements of changes in ultrasonic attenuation together with changes in ultrasonic velocity have been made concurrently with load-strain measurements in tensile tests on the same specimen of aluminium. The results of such measurements taken during loading of the specimen, during relaxation or recovery at constant strain, and during unloading show a number of interesting effects. These observed effects are interpreted in terms of dislocation behaviour for the various stages of the experiment. The experimental results for attenuation α and velocity change $\Delta v/v$ permit the calculation of changes in dislocation density and loop length based on a dislocation damping theory recently developed to include both megacycle and kilocycle frequencies. The strain due to dislocation motion was calculated with a simple model and with dislocation loop lengths and densities obtained from the data and the theory just mentioned. The comparison of the calculated strain and the measured strain lends support to the use of this model, and while this dislocation damping model may not be entirely correct it does seem to be possible to obtain information about stress–strain behaviour at low strains from sound propagation data alone. A.

534.22

6443. VELOCITIES OF SOUND IN INDIVIDUAL LIQUIDS AND LIQUID MIXTURES. B.B.Kudryavtsev.
Akust. Zh., Vol. 1, No. 1, 39-50 (1956). In Russian.

A thermodynamic calculation is carried out for the velocity of sound in a pure liquid and in a binary mixture and comparison made with experimental results. The agreement is satisfactory. The theory developed also enables velocities of sound in anomalous mixtures (aqueous solutions) to be worked out again giving satisfactory agreement with experiment. The method is further extended to calculations for tertiary and more complex mixtures. 24 refs., (mainly Russian). C.R.S.Manders

534.22

6444. VELOCITY OF PROPAGATION OF ELASTIC WAVES IN NOT QUITE ELASTIC MEDIA (SIGNAL VELOCITY). D.I.Shil'krut.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 1, 58-60 (1956). In Russian.

Theoretical discussion of the relation between the velocity of the wavefront and of the signal in a dispersive viscoelastic medium. J.M.Hough

534.22

6445. ULTRASONIC VELOCITY IN ZINC AND MAGNESIUM SULPHATE SOLUTIONS AT DIFFERENT CONCENTRATIONS AND TEMPERATURES. B.S.Mohanty and B.B.Deo.
Indian J. Phys., Vol. 28, No. 12, 577-80 (Dec., 1955).

Ultrasonic velocity in zinc and magnesium sulphate solutions was measured over a concentration range 0.05 to 0.5 molar (m) and over a temperature range 25°C to 45°C. The values of adiabatic compressibilities were computed. A.

534.22

6446. TEMPERATURE COEFFICIENT OF THE SPEED OF SOUND IN WATER NEAR THE TURNING POINT. M.Greenspan, C.E.Tschiegg and F.Breckenridge.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 500 (May, 1956).

A sing-around ultrasonic velocimeter was used to locate the temperature for which the velocity of sound in water is a maximum at 73.95°C. It is suggested that water held near this temperature is a suitable standard for intercomparison and calibration of instruments. A.

534.2

6447. EFFECT OF DISSOLVED AIR ON THE SPEED OF SOUND IN WATER. M.Greenspan and C.E.Tschiegg.
J. Acoust. Soc. Amer., Vol. 28, No. 3, 501 (May, 1956).

A sing-around ultrasonic velocimeter (see preceding abstract) was used to show that dissolved air has a negligible effect (less than 10 p.p.m.) on the speed of sound in water at 31.8°C and 0°C.

534.222.2 : 534.23/.2

6448. THE TRANSMISSION AND REFLECTION OF AN EXPONENTIAL SHOCK WAVE IMPINGING ON A HOMOGENEOUS ELASTIC PLATE IMMERSED IN A LIQUID. G.Lindh.
Acustica, Vol. 5, No. 5, 257-62 (1955).

By means of a Laplace transform it has been possible to characterize satisfactorily, from a physical point of view, the reflection and transmission of a plane exponential wave with normal incidence to an elastic plate immersed in a liquid. Furthermore, the waves travelling inside the plate have been considered. It was then found that the transmitted as well as the reflected wave may be represented by a discontinuous function with a finite jump at times corresponding to twice the plate thickness. The theoretical results have been verified experimentally by studying the change of the exponential pressure-time curve produced by an underwater explosion in the case of reflection at and transmission through a concrete plate immersed in water. Tests have also been made with a combination of different plates and the agreement between theory and experiment seems to be satisfactory. A

534.222.2

6449. UNIDIMENSIONAL TRANSIENT FLOW OF A PERFECT GAS WITH STRONG SHOCK WAVES. G.G.Chernyĭ.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 5, 657-60 (1956). In Russian.

Previous studies of the problem have been mainly concerned with self-similar flows. The author's approximate calculation method, based on an expansion of the solution in powers of $(\gamma - 1)/(\gamma + 1)$, where γ is the ratio of specific heat can also be applied to other types of flow. To illustrate the proposed procedure, the author solves the problem of self-similar flow arising from the motion of a piston according to power law. A.Gelbtuch

534.222.2 : 523.87

6450. PRODUCTION OF SHOCK WAVES AT STELLAR SURFACES. G.M.Gandel'man and D.A.Frank-Kamenetskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 6, 811-14 (1956). In Russian.

An application of gas dynamics to the conditions existing in the outer layers of a star. J.M.Hough

534.222.2 : 533.

6451. SHOCK LOCATION IN FRONT OF A SPHERE AS A MEASURE OF REAL GAS EFFECTS. R.N.Schwartz and J.Eckerman.
J. appl. Phys., Vol. 27, No. 2, 169-74 (Feb., 1956).

Spheres were fired at supersonic speeds into monatomic gases and into chlorine gas. The position of the shock wave which forms in front of the sphere depends on the Mach number and gas state before and after crossing the shock wave. Measurements of position made in monatomic gases agree fairly well with aerodynamic theory. As the shock position depends on the actual gas state attained, and thus molecular excitation times, measurements in more complicated gases than a monatomic gas can give information as to amount and rates of excitation. The vibrational energy excitation in chlorine was singled out for study. This excitation involves a well known rate process. By carrying out shock position measurements at several different pressures, it is possible to infer the order of magnitude of the vibrational relaxation time in chlorine; the present results are in agreement with shock-tube measurements of the relaxation time. A

534.222.2

52. SHOCK WAVES IN THE PRESENCE OF IONIZATION I MONATOMIC GASES. W.J.Guman.
appl. Phys., Vol. 27, No. 6, 663 (June, 1956).
A fairly simple method for computing the gas-dynamical rameters across either oblique or normal shock waves in e presence of ionization of a monatomic gas, is developed. wo equations, obtained by application of the conservation nd Saha equations and the equation of state to a stationary blique shock wave, can be solved, with reasonable accuracy nd speed, on a slide rule. Numerical results, for a normal hock wave, agree with results obtained by Resler et al. Abstr. 681/1953). J.S.G.Thomas

534.222.2

453. INTERACTION OF TWO POWERFUL ONE-DIMEN- ONAL SHOCK WAVES. K.Hain.
..Naturforsch., Vol. 11a, No. 6, 329-39 (1956). In German.
The two types of possible interaction between two powerful ne-dimensional shock waves, namely, collision and over- king, are discussed mathematically for the case of waves hich have already attained their asymptotic stable form, orresponding to the homologous distribution factor K = 0.39. t the case of collision, for which, up to the present, only an pproximate solution has been derived, numerical calculations how that the development of shock waves with time is essen- ally independent of the initial Mach number, and that all hock waves after reaching the same homologous distance, = −0.7 from the point of collision, practically disappear. In e case of overtaking waves, calculations show that the tability of the homologous solution corresponding to K = 0.39 s renewed, after the waves meet, the whole wave distribution ery quickly reverting to this homologous distribution. J.S.G.Thomas

534.23/.24

454. AN EXTENDED METHOD OF MEASURING SYMMET- ICAL FILTERS. W.K.R.Lippert.
custica, Vol. 5, No. 5, 269-73 (1955).
Presents the theory and experimental procedure for deter- ining the characteristic reflection and transmission factors f symmetrical filters and discontinuities with a reflecting utput duct. A.

534.23 : 535.11 : 536.33 : 538.56

455. RADIATION FROM A SPHERE IN THE PRESENCE OF SELF ABSORPTION. M.A.Bak, K.A.Petrzhak and Yu.F.Romanov.
Zh. tekh. Fiz., Vol. 26, No. 2, 379-84 (1956). In Russian.
A mathematical treatment of a sphere with a uniform ate of radiation throughout and a constant coefficient of bsorption (μ). It is shown that the effect of absorption de- ends on μR where R is the radius and a table is given for $0 \leq \mu R \leq 10$. J.M.Hough

534.23

456. EFFECT OF DISLOCATIONS ON ULTRASONIC WAVE ATTENUATION IN METALS. W.P.Mason.
Bell Syst. tech. J., Vol. 34, No. 5, 903-42 (Sept., 1955).
A survey of the relaxation effects in strained metals and f their interpretations is given, and their significance in the ropagation of ultrasonic attenuation discussed. At low tem- eratures and low stresses a relaxation peak occurs which is ontrolled by an activation energy of less than 0.1 eV per atom n several metals; this is attributed to the movement of dis- ocations over the potential barriers of the crystal structure. At higher temperatures effects occur which are attributed to he release of dislocations from impurity atoms, while in poly- rystals grain boundary damping, controlled by an activation nergy nearly equal to that for self-diffusion, becomes impor- ant. Other effects have been observed in heavily worked naterials, and these are described. W.M.Lomer

534.23

6457. ON ULTRASONIC WATTAGE AND SPECTRAL NUM- BER RELATIONSHIP. K.Samal, K.M.Patanaik and A.K.Dutta.
Indian J. Phys., Vol. 29, No. 11, 548-57 (Nov., 1955).
An experimental study has been made between the input wattage and the maximum number of spectral orders for dif- ferent coils and different circuits. The nature of variation of the order number against the wattage is described by an empir- ical relation of the form $w = bn^2 + cn^3$. It has been observed that the relation obtained by Raman and Nagendra Nath, when suitably analysed, is in complete accord with the experimental results. A possible reorientation of Raman and Nagendra Nath's theoretical relation to suit this aspect of ultrasonic study has been suggested. A.

534.232 : 537.228.1

6458. NON-DIRECTIVE CERAMIC SOUND RECEIVERS. A.A.Anan'eva.
Akust. Zh., Vol. 2, No. 1, 10-27 (1956). In Russian.
An examination is made of piezo-electric sound receivers, possessing spherical and cylindrical directivity and consisting of a thin envelope of barium titanate ceramic. With suitable choice of the material and appropriate arrangement of elec- trodes it is possible to obtain great sensitivity with good direc- tivity characteristics. C.R.S.Manders

534.232 : 534.321.9

6459. A POWERFUL ULTRASONIC INSTALLATION FOR IRRADIATING MICRO-ORGANISMS. I.V.Skards.
Akust. Zh., Vol. 2, No. 1, 84-92 (1956). In Russian.
The paper describes a powerful unit for irradiating, with ultrasonic oscillations, biological specimens contained in ampoules. Described also are the special measures taken in the electrical and acoustic parts of the installation for ensuring the constancy of ultrasound intensity in the irradiated speci- men. C.R.S.Manders

534.232

6460. SONIC RADIATION FROM A ROTATING DIPOLE. L.N.Sretenskiĭ.
Akust. Zh., Vol. 2, No. 1, 93-8 (1956). In Russian.
The axis of a dipole, the moment of which changes periodically with time, possesses a certain motion in space. The paper investigates the acoustic field of such a dipole for the cases where there is uniform rotation of the dipole or a harmonic change in the angle of the dipole axis with unchanged direction in space. C.R.S.Manders

534.232

6461. A METHOD FOR THE MEASUREMENT OF THE DIRECTIVITY FACTOR. G.Sacerdote and C.B.Sacerdote.
Acustica, Vol. 6, No. 1, 45-8 (1956).
An electromechanical apparatus for the direct determin- ation of the directivity factor of a loudspeaker: it can be em- ployed to determine in a very short time its characteristics of directivity as a function of frequency. A.

534.232

6462. MECHANIC-ELECTRIC TRANSDUCER. K.S.Lion.
Rev. sci. Instrum., Vol. 27, No. 4, 222-5 (April, 1956).
Description of a transducer system which permits the conversion of mechanical displacements into electrical signals. The system is based upon a high-frequency discharge in a gas under reduced pressure. Different modifications permit the detection of either very small movements (< 1 mm) or large movements (several cm), or small changes of capacitance (fraction of a micro-microfarad). A.

534.232

6463. THE EFFICIENCY OF AN OSCILLATING QUARTZ CRYSTAL IN LIQUIDS. S.Parthasarathy and V.Narasimhan.
Z. Phys., Vol. 145, No. 5, 592-6 (1956).
The investigations carried out on the estimation of the

conversion efficiency of a piezoelectric quartz crystal oscillating in organic liquids of varying sound absorption coefficients is reviewed, and some of the possible causes for the variation in efficiency are discussed. A.

534.24

6464. REFLECTION OF A PLANE ACOUSTIC WAVE FROM A SURFACE OF NONUNIFORM IMPEDANCE. H.S.Heaps.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 666-71 (July, 1956).

A theoretical analysis is made of the reflection of a plane wave of sound from a surface whose acoustic impedance is not uniform. The sound pressure received at a distant point consists of a specularly reflected wave plus scattered radiation. The magnitude of the specularly reflected wave is independent of wavelength and depends upon the impedance of the portion of the surface which may be viewed at the specular angle from the receiver. If the impedance differs only slightly from a constant value the directivity pattern of the scattered radiation is determined by the product of three factors. The condition for the scattered radiation to obey Lambert's cosine law is that the reflecting surface is one of approximately zero pressure and that there is no correlation in the impedance irregularities. The condition for perfectly diffuse scattered radiation is that the surface behave as approximately rigid with no correlation in the impedance irregularities. In the case of a surface whose impedance irregularities have a slow statistical variation with position the scattered radiation is confined to a beam whose axis lies along the direction of specular reflection but the energy within the beam is not necessarily closely confined to the specular angle. A.

534.24

6465. REFLECTION OF PLANE SOUND WAVES FROM AN IRREGULAR SURFACE. J.G.Parker.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 672-80 (July, 1956).

A plane sound wave is assumed to be incident upon an irregular pressure release surface $z = \zeta(x, y)$. The solution for the reflected field is regarded as a superposition of plane waves having an amplitude spectrum $A(k_1, k_2)$. Next, the Fourier transform $(G(x, y)$ of $A(k_1, k_2)$ is introduced and subjected to the boundary condition on ζ. This leads to an integral equation for $G(x, y)$ that cannot be readily solved. However, if one causes $G(x, y)$ to depend exponentially on a function $u(x, y)$, then a differential equation may be derived from this integral equation, the solution of which gives an approximate form of $u(x, y)$; the degree of approximation involved depends on the smallness of ζ. This method is applied to the problem of sound scattering from a one-dimensional sinusoidally corrugated surface and the results compared with experimental measurements of LaCasce and Tamarkin and also with the results of a theory due to Rayleigh. This comparison shows the predictions of the theory presented here to be as good as the Rayleigh theory in all cases and closer in the majority of cases. A.

534.321.7

6466. ON THE INFLUENCE OF TONE SYSTEMS ON THE STANDARD PITCH. H.Meinel.
Acustica, Vol. 5, No. 5, 284-8 (1955). In German.

For natural tone systems, particularly those employing the harmonic series, the standard for a^1 of 440 c/s is not unique, for such a system possesses in theory, an infinite series, in practice many different values for a^1. Using note examples quoted by Max Planck it is shown that even with the same tuning, various pitches can occur during playing. A proposal for a standard is given which avoids these difficulties more or less. A.

534.512.1

6467. ON POWDER STRIATIONS PRODUCED BY ELECTRIC SPARKS. M.D.Waller.
Proc. Phys. Soc. B, Vol. 69, Pt 5, 548-52 (May, 1956).

The powder striations which may be produced, on either flat surfaces or in tubes, by means of electric sparks are shown to be similar to those obtained in a sound field due to a mechanical vibrator; that is to say they depend upon the presence of aerial vortices. Comparisons of published records show that the frequencies of vibration involved lie in the lower ultrasonic range, and must derive from the shock wave which is associated with the spark. There is no direct relation between the inter-striation distances and the frequencies of the electric circuit. A.

534.61

6468. ULTRASONIC INTENSITY METER. C.A.Wiederhielm.
Rev. sci. Instrum., Vol. 27, No. 7, 540-1 (July, 1956).

A calorimetric method for measuring ultrasonic intensities is described. By the use of agar, the formation of standing waves and the disturbance of the ultrasonic field being measured is avoided. Intensities in a small area can be measured, making it possible to get valid readings of peak intensities in a large nonuniform ultrasonic field. A

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85.

534.78

6469. GROWING POINTS IN MULTICHANNEL COMMUNICATION. D.E.Broadbent.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 533-5 (July, 1956).

The numerous experiments on multichannel listening allow certain broad conclusions: that the listener has a limited capacity, that therefore much of the information presented to him is discarded, and that this discarding is made easier when the signals to be ignored share certain physical characteristics which the desired signals do not have. These conclusions suggest further lines of advance. The same speech signals may interfere with each other more when they are chosen from a larger ensemble. This implies that the information content must be considered. In addition, momentary peaks of information are handled by a curious form of immediate memory in the listener. A.

534.78

6470. ON THE TRANSMISSION AND CONFIRMATION OF MESSAGES IN NOISE. J.P.Egan, F.R.Clarke and E.C.Carterette.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 536-50 (July, 1956).

In several experiments, the restrictions imposed upon the communication process by an articulation test were relaxed by increasing the number of events in the communication sequence. A communication event is the transmission of a message from the source to the receiver followed by the return of a message (correct or incorrect) from receiver to source for confirmation. Although both source and receiver serve as talker and listener, the relation between them is asymmetric. Since the source knows the original message, he must accept or reject the message sent back to him according to some criterion. Various types of communication events arise depending upon (1) whether or not the receiver correctly hears the message, and (2) whether or not the source confirms the message returned by the receiver. The various probabilities associated with these events are investigated as a function of speech-to-noise ratio. The behaviour of the source is examined in terms of the relation between the two conditional probabilities associated with a correct and with an incorrect confirmation. If each message is sent repeatedly until all are confirmed, a sequence of communication events is generated. A simple mathematical model accurately describes this process. A.

534.78

6471. EFFECTS OF TWO MESSAGE-STORAGE SCHEMES

ON COMMUNICATIONS WITHIN A SMALL PROBLEM-
LVING GROUP. W.F.Bertsch, J.C.Webster, R.G.Klumpp
P.O.Thompson.
Acoust. Soc. Amer., Vol. 28, No. 4, 550-3 (July, 1956).
Each of four men spoke messages at predetermined times
central operator over an independent communication
nnel. Each message consisted of an address, a station
ntification, and three pieces of information. The operator
ntified relevant messages by the address and/or station
ntification and transcribed the information symbolically
o a plotting board. Message density varied from the over-
ping of two or three messages to gaps of 20 seconds between
gle messages. The purpose of the study was to evaluate two
ssage storage schemes. In one scheme the messages could
delayed by 9 seconds at the option of the operator (fixed-
ay), in the other every message was stored until the opera-
called for it (variable-delay). The fixed-delay and variable-
ay message storage schemes were compared to a no-help
-delay) condition, where the operator had no control over
sequence of messages. The criteria used to evaluate the
rage schemes were (1) the number of message repeats re-
sted by the operator (and the associated time delays) and
the number of messages incorrectly transcribed (or not
nscribed). The variable-delay storage scheme was superior
all criteria, that is, fewer repeats were requested and few-
errors were made. The fixed-delay scheme was difficult to
and was not always superior to the no-help case. A.

534.78

72. STUDY OF MAYDAY AND S.O.S. AS RADIOTELEPH-
Y DISTRESS SIGNALS. K.K.Neely.
Acoust. Soc. Amer., Vol. 28, No. 4, 554-5 (July, 1956).
Mayday and S.O.S. were compared in the presence of noise
d speech to determine their relative detectability values
udibility thresholds). Results of the tests indicated that
O.S. had the lower audibility threshold and therefore the
eater detectability value. A.

534.78

73. UNDERWATER COMMUNICATION. R.D.Isaak.
Acoust. Soc. Amer., Vol. 28, No. 4, 556-7 (July, 1956).
To test several types of voice and code signals, communi-
tion was carried on over the conventional submarine under-
ter telephone between two submerged submarines. The
gnals included normal speech, differentiated and clipped
eech, quarter-speed speech and multiple-tone Morse code.
was found that normal speech was received at least as
liably as any of the more elaborate signals tried. A.

534.78

74. SPEECH RECEPTION AND TEMPORARY HEARING
OSS AS A FUNCTION OF EXPOSURE TO HIGH-LEVEL
OISE. G.C.Tolhurst.
Acoust. Soc. Amer., Vol. 28, No. 4, 557-60 (July, 1956).
Two studies were made to assess the effects of high-level
ise (1) upon efficiency in speech reception and (2) in causing
mporary hearing losses. Over 1400 observers made re-
onses under various sound-pressure levels for each of 13
fferent noise spectra. It was found that: (1) Increases in
ise level always adversely affected speech reception, while
anges in spectra did not always have an effect; time-in-noise
d not progressively decrease scores. (2) Hearing threshold
ifts of 4 to 5 dB were found after a 2 hr noise exposure;
rtain spectra caused greater threshold shifts than others.
A.

534.78

75. INTELLIGIBILITY OF UHF AND VHF TRANSMIS-
ONS AT FIFTEEN REPRESENTATIVE AIR TRAFFIC CON-
ROL TOWERS. H.R.Beitscher and J.C.Webster.
Acoust. Soc. Amer., Vol. 28, No. 4, 561-4 (July, 1956).
A comparison of the intelligibility of u.h.f. and v.h.f. com-
unications was made between "plane to tower" and "tower to plane" at fifteen control towers. A specially equipped plane was flown in a circle with a 20 mile radius for these tests. Voice Communication Laboratory multiple-choice word lists were read by two talkers, one in the plane and the other in the tower. These messages were recorded on tape in both places. Five subjects listened to these recordings in the laboratory, and their responses were scored for accuracy against the original word lists. The percentage of words heard correctly from tower to plane varied from 90% to 38% with an average of 73.7% and was much higher than the corresponding percentage from plane to tower of 63% to 3% with an average of 44.4%. There was very little difference between the intelligibility of v.h.f. and u.h.f. In general, those towers that had high plane-to-tower scores also had high tower-to-plane scores: the correlation among towers between hearing and being heard was fairly high. A.

534.78

6476. TWO SCHEMES OF SPEECH COMPRESSION SYSTEM. S.-H.Chang.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 565-72 (July, 1956).
Since the wave form of speech is apparently continuous and the phonemic entity is discrete, it is reasonable to expect that during the developmental stages of speech compression systems the process will gradually evolve from continuous to mixed discrete-continuous and finally to a completely discrete type. Two plans for such systems are discussed. Plan I is an attempt to use two discrete features of speech together with continuous extraction of the formants, moments, and pitch of speech. Plan II is an attempt to identify phoneme-like elements through a scheme of successive selection. A.

534.78

6477. SOME SYSTEMS FOR SPEECH-BAND COMPRESSION. F.Vilbig and K.H.Haase.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 573-7 (July, 1956).
Speech-band compression aims to reduce the frequency band width without impairing the desired informational content Physical compression systems are of two types: spectrum-alteration systems and vocoder (voice coding) systems. Spectrum alteration is not restricted to speech, is relatively simple to perform, but achieves only a compression factor of 3 to 5. Considerably higher ratios (10 to 20) are obtainable by vocoder-type systems. Here, by a spectrum analysis on the transmitter side, a "pitch" frequency is extracted and a system function is derived. Both are then transmitted to a receiver where speech is synthesized. At the A.F.Cambridge Research Center, the following vocoder-type systems are being developed and investigated: the scan vocoder with envelope scanning, the pulse vocoder in which the envelope is coded, and the formant vocoder in which the envelope is represented by three formant frequencies. By means of alterations and additions, the scan vocoder can be transformed into a pulse or a formant vocoder. A.

534.78

6478. STUDIES OF FORMANT TRANSITIONS USING A VOCAL TRACT ANALOG. K.N.Stevens and A.S.House.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 578-85 (July, 1956).
An electrical analogue of the vocal tract is used to obtain experimental relations between certain idealized articulatory parameters and formant frequencies associated with the transitional and stop portions of vowel-consonant syllables. The data are discussed in terms of the "locus hypothesis" proposed by Delattre, Liberman, and Cooper (Abstr. 7796/1955) and in terms of simple resonator theory. It is concluded that the results modify the hypothesis that assigns one second-formant locus to all vowel-consonant transitions involving a given class of stop consonants. In particular, the second-formant loci for transitions to velar and bilabial stop consonants appear to vary over a range of frequencies depending on the vowel, while loci for post-dental stop consonants are relatively invariant. Characteristics of first- and third-formant loci are discussed briefly. A.

534.78

6479. NATURALNESS AND DISTORTION IN SPEECH-PROCESSING DEVICES. E.E.David, Jr.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 586-9 (July, 1956).

In evaluating a speech-processing device, the result of applying a suitable fidelity criterion to its output and the tolerance within which the reduced signals must be represented to satisfy this criterion, as well as the corresponding band width, are important. These factors establish a measure of the efficiency of the particular representation achieved by the device. This quantity can be utilized to compare it with systems having known characteristics. An important constraint is that the systems being compared have equal fidelity according to the criterion being used. The quantitative result of this comparison depends markedly upon the criterion selected. It should be chosen with the contemplated application in mind and can be either objective or subjective in nature. Since speech processing devices operate on the basis of an objective criterion, it appears that as future research establishes relations between subjective impressions and physical measurements, better and perhaps even the ultimate speech-processing devices will become realities. A.

534.78

6480. ON PREDICTING THE INTELLIGIBILITY OF SPEECH FROM ACOUSTICAL MEASURES. K.D.Kryter.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 590 (July, 1956).

534.78

6481. EXPERIMENTAL STUDIES OF TIME COMPRESSION OF SPEECH. G.Fairbanks.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 591 (July, 1956).

534.78

6482. ELECTRONICALLY TUNABLE SELECTIVE AMPLIFIER FOR FORMANT SYNTHESIS. G.M.Badoyannis, D.Molony, S.Fich and J.J.Slade, Jr.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 591 (July, 1956).

534.78

6483. BAND WIDTH AND CHANNEL CAPACITY NECESSARY TO TRANSMIT THE FORMANT INFORMATION OF SPEECH. J.L.Flanagan.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 592-6 (July, 1956).

Computations of the band widths and signal-to-noise ratios necessary for the transmission of continuous data on the first three formants of speech are presented. The results indicate that, on the average, band widths of 7.1, 6.7 and 5.3 c/s and signal-to-noise ratios of 33, 24 and 20 dB are sufficient for the transmission of signals specifying the frequencies of the first, second and third formants, respectively. The band-width and signal-to-noise figures are computed on the basis that the error incurred in each formant signal is less than the just discriminable difference in formant frequency at least 65% of the time. The channel capacity necessary for the transmission of the three formant signals is, therefore, of the order of 200 bits per second. A.

534.78

6484. ARTICULATION REDUCTION BY COMBINED DISTORTIONS OF SPEECH WAVES. D.W.Martin, R.L.Murphy and A.Meyer.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 597-601 (July, 1956).

Previous investigators have shown that speech waves can undergo any one of a number of severe forms of distortion in low ambient noise levels without serious reduction of word articulation. There are well-known notable exceptions (e.g. centre clipping). However, it is not enough to avoid these exceptional forms of distortion. In the study reported here it has been demonstrated that combinations of speech-wave distortions, which individually are quite innocuous with regard to word articulation, can be devastating in their combined effect, even in the absence of serious noise. Four types of speech-wave distortion were studied, individually and in combination as follows: gross attenuation of high-frequency components, multiple echo, random amplitude modulation and gross irregularity of response-frequency characteristic. Ambient noise was also a controlled environmental condition in some phases of the investigation. A

534.78

6485. MASKED THRESHOLD AND ITS RELATION TO THE DURATION OF THE MASKED STIMULUS. E.J.Thwing.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 606-10 (July, 1956).

Previous investigations have shown that the masking capacity of a prolonged auditory stimulus remains constant over its duration in spite of its great diminution in loudness. The experiments which follow were designed to determine the relation between the masked threshold and the duration of the masked stimulus. The results show that (1) within limits, as the duration of a pure tone is increased less noise is required to mask the tone, (2) the magnitude of this effect increases as a function of frequency of the masked tone but appears to be independent of its SPL, and (3) in general, these effects diminish somewhat with practice. A

534.78

6486. TEMPORARY THRESHOLD SHIFT AS AN INDEX OF NOISE SUSCEPTIBILITY. J.F.Jerger and R.Carhart.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 611-13 (July, 1956).

Temporary threshold shift after auditory fatigue was measured in 178 subjects with normal hearing prior to their placement in an environment of high-level noise. In addition, two audiograms were made: one, prior to the noise exposure period; the second, eight weeks after its termination. Results indicated that ears showing hearing losses at 3000 and 4000 c eight weeks after the noise exposure tended to show longer recovery times on the prenoise exposure fatigue test than ears with no change. These findings are discussed in relation to the prediction of noise susceptibility. A

534.78

6487. AUDITORY DETECTION OF THE PRESENCE AND ABSENCE OF SIGNALS IN NOISE. G.Fairbanks; A.S.House and J.Melrose.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 614-16 (July, 1956).

An experiment is described in which detection of the absence of signal remained high and relatively constant while detection of intermixed signals varied over the threshold region as a function of signal voltage. Statistical signal detection thresholds of observers with set to detect absence of signal were approximately 2 dB lower than those of observers with set to detect signal. A

534.78

6488. MASKING OF TONES BY BANDS OF NOISE. R.C.Bilger and I.J.Hirsh.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 623-30 (July, 1956).

Measurements were made of the masking of pure tones by bands of noise, each band width corresponding to a pitch interval of 250 mels, with band level varied from 40 to 120 dB (above 0.0002 microbar). A modified Békésy audiometer permitted recording as a function of frequency, so that masked audiograms could be compared with the noise spectra to ascertain how well the ear followed the frequency characteristics of the noise bands at different levels. It was found that values for the critical band according to Fletcher and to Hawkins and Stevens predict quite precisely the masking for tones whose frequencies lie within the band. More masking than would be predicted is found for frequencies above the band, the discrepancy increasing as the noise level increases. Below the band, the masked threshold is again predicted precisely by the critical-band hypothesis, but only to a point, beyond which, for high noise levels, a "remote" masking is observed that is constant with frequency for any particular level and is much more than can be predicted from the effective levels (from

either system noise or imperfect band rejection) obtaining at those low frequencies where this masking is observed. Whereas masking for tones within the band increases linearly with level, this "remote" masking rises in an accelerated manner, as a function of level, and then shows deceleration at the highest levels. Some speculative interpretation is attempted. A.

534.833 : 621.314.21

6489. THE DESIGN OF SOUND BARRIERS FOR POWER TRANSFORMER A.F. NOISE. K.Fukushima, T.Nimura, K.Shibayama, K.Kido, I.Sugai, H.Sakamizu and T.Ishigaki.
J. Inst. Elect. Engrs Japan, Vol. 75, 471-5 (May, 1955). In Japanese.

The noise level at dwelling houses 20 m distant from a 3-phase 6000 kVA transformer was 40-50 phon. To obtain the necessary data for designing the barrier, the following measurements were made, (1) the noise intensity and its components, (2) the noise reduction effect by various model barriers scaled down 10 : 1, and (3) the sound absorption and insulation properties of the sound barrier materials. As a result trough-shaped barriers 4.5 m high were designed. They consisted of two types of concrete block, one filled with sand the other behaving as a resonance chamber. With these arranged alternately, the noise level was reduced to 20-30 phon.
H.G.M.Spratt

534.833

6490. NOISE ATTENUATION OF DISSIPATIVE MUFFLERS. I.Dyer.
Noise Control, Vol. 2, No. 3, 50-7, 78-9 (May, 1956).

534.837

6491. SOME SPECIAL ASPECTS OF THE NOISE PRODUCED BY MODERN AEROPLANES. P.Chavasse and R.Lehmann.
Acustica, Vol. 5, No. 6, 289-97 (1955). In French.

After recapitulating the numerous results obtained in past years on aircraft noise, the authors describe their own measurements of the spectra of modern aircraft in the sonic, infrasonic and ultrasonic range. They give some account of their technique of measurement and show the necessity of both physical and physiological measurements of such sounds. A.

534.837 : 621.313.333.2

6492. VIBRATION AND NOISE IN SQUIRREL-CAGE INDUCTION MOTORS. A.Isizaki.
J. Inst. Elect. Engrs Japan, Vol. 75, 451-8 (May, 1955). In Japanese.

These are caused by harmonic components of the airgap flux, which in turn arise from the winding distribution and the irregularity of the airgap permeance due to the slot openings. The subject is studied quantitively, a formula for the distributed radial forces being derived and a method of calculating the resulting vibration and noise demonstrated. The theoretical formula is simplified, the main factors influencing the radial forces investigated and the important part played by the airgap permeance and the actual number of slots is explained. In deciding on the number of rotor slots, consideration must be given to the radial force distribution and the dimensions of the motor. Examples of calculations are given.
H.G.M.Spratt

534.839

6493. MEASUREMENT OF THE NOISE OF DUCTED FANS. C.G.Van Niekerk.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 681-7 (July, 1956).

A proposed technique for measuring the noise of a ducted fan by means of a microphone placed inside the fan duct was evaluated by comparing results so obtained with those obtained by measuring the total sound energy radiated from the duct into a reverberation chamber. A suitable microphone windscreen was developed and was used to reduce the aerodynamic self-noise generated by the microphone to a negligible minimum. Good correlation was obtained and by studying transverse resonance conditions in a duct it was attempted to show how suitable microphone stations could be found to eliminate measuring errors caused by the existence of standing waves. A.

534.846.6

6494. ACCURACY OF MATCHING FOR BOUNDING SURFACES OF ACOUSTIC MODELS. A.F.B.Nickson and R.W. Muncey.
Acustica, Vol. 6, No. 1, 35-9 (1956).

Many workers have accepted the theory that an acoustic model can be made which will duplicate the acoustic behaviour of a given space. As perfect matching is physically impossible, a theoretical study has been made to show how much a small difference in impedance will affect the correlation, and conversely what differences in impedance are comparable with tolerances in the model measurement. Areas on a chart connecting acoustic impedance with certain parameters can be prescribed within which the acoustic impedance matching should be satisfactory, the area varying with the acceptable tolerance. A.

534.85

6495. ESTIMATION OF THE AUDIBILITY OF NON-LINEAR DISTORTIONS IN A SOUND TRACK.
A.V.Rimskiĭ-Korsakov.
Akust. Zh., Vol. 2, No. 1, 51-61 (1956). In Russian.

It is proposed to define the audibility of non-linear distortions by an estimate of the probability that the results of non-linear distortions will exceed the threshold of the masking set-up by a basic signal carried on a sound track, and the threshold of audibility in the conditions of a given auditorium. A theoretical, approximate evaluation of this probability is given and a calculation made for the simplest possible case, that of equal amplitude frequency spectrum of the signal and square law characteristic of non-linearity. The actual threshold of perception of distortions in this case corresponds to a 2-3% harmonic coefficient. C.R.S.Manders

OPTICS. RADIATION. SPECTRA 535

535.317

6496. THE DERIVATION OF GULLSTRAND'S BASIC EQUATIONS FOR OBLIQUE RAY BUNDLES FROM THE PRINCIPAL CURVATURES OF THE WAVE FRONTS.
O. Altrichter and G.Schäfer.
Optik, Vol. 13, No. 6, 241-53 (1956). In German.

The equations due to Gullstrand are obtained by considering the shape of the wavefront after passage through a spherical refracting surface. R.W.Fish

535.317.1

6497. CORRESPONDENCE IN AMPLITUDE BETWEEN A PLANE OBJECT AND ITS IMAGE FORMED BY A CENTRED OPTICAL SYSTEM. P.Dumontet.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2320-2 (May 7, 1956). In French.

The image can be considered as a filter, in terms of the Fourier transform of the transparency of the exit pupil for a small central region only. A better approximation can be obtained by taking into account phase effects, and experiments are described illustrating the principles involved. R.W.Fish

535.317.1

6498. THE FREQUENCY RESPONSE OF OPTICAL SYSTEMS. H.H.Hopkins.
Proc. Phys. Soc. B, Vol. 69, Pt 5, 562-76 (May, 1956).

In optical systems the pencils forming images of extra-axial object points are generally oblique to both the object and image planes. The diffraction image of a point source observed in an oblique image plane differs significantly from that obtained in a plane normal to the image-forming pencil. The theory of the frequency response of optical systems is formu-

lated for this more general case. The resulting formulae are used to relate the response obtained between object and image planes perpendicular to the optical axis to that obtained between planes perpendicular to the principal rays. It is shown that no loss of generality is introduced by the restriction to unidimensional objects. Some general properties of the response function for optical systems having aberration are derived. A.

535.321

6499. SHIELDING ERRORS IN CRITICAL ANGLE REFRACTOMETRY. J.W.Forrest.
J. Opt. Soc. Amer., Vol. 46, No. 8, 657-60 (Aug., 1956).

A mathematical and an experimental examination of the errors which may exist in critical angle refractometry when an illuminating prism is used to retain a thin stratum of a liquid sample against a measuring prism. A.

535.323 : 535.345 : 535.39 : 531.717

6500. THE WAVELENGTH VARIATION OF THE OPTICAL CONSTANTS OF THIN SILVER FILMS. J.Trompette.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2322-4 (May 7, 1956). In French.

The optical constants of a silver film (16.3 mμ) were measured for 2300 A $\leq \lambda \leq$ 7000 A by Malé's method (see Abstr. 3272/1954). κ showed a sharp minimum and ν was equal to unity at the wavelength of maximum transmission. The dispersion curve is opposite to the one usually observed near absorption bands, as expected. R.A.Weale

535.33

6501. CLEBSCH–GORDAN COEFFICIENTS FOR $j_2 = 5/2$. R.Saito and M.Morita.
Progr. theor. Phys., Vol. 13, No. 5, 540-2 (May, 1955).

The explicit forms of the Clebsch–Gordan coefficients, $(j_1 5/2\, m_1 m_2 | j_1 5/2\, j\, m)$, are given. A.

535.33.03 : 523.872

LABORATORY EXCITATION OF THE BLUE-GREEN BANDS OBSERVED IN THE SPECTRA OF N-TYPE STARS.
See Abstr. 5649

535.33.03 : 536.46

6502. FLAME ZONE SPECTROSCOPY OF SOLID PROPELLANTS. II. DOUBLE BASE PROPELLANT JPN. R.G.Rekers and D.S.Villars.
J. Opt. Soc. Amer., Vol. 46, No. 7, 534-7 (July, 1956).

For Pt I, see Abstr. 7266 (1954). With the aid of the automatic-feed strand bomb described in Pt I spectra of JPN burning in nitrogen have been investigated over the visible and ultraviolet. Throughout the pressure range, 300 to 500 lb/in^2 nitrogen, emission from the flame zone exhibits a continuous background which extends into the ultraviolet to approximately 3200 A. Accompanying this continuum are some of the more prominent lines of spectra due to sodium, potassium, calcium, copper and iron. Calcium oxide bands in the 6260 region (orange system) and in the 5500 region (green system) have been identified. Furthermore, a multitude of weak lines is observed in the wavelength region, 4600 to 5800 A. Both the Swan and the high pressure bands attributed to C_2 appear to be present in this flame. The dividing line between flame and fizz zones does not appear to be sharp. No absorption in the visible region has been found in the fizz zone over the pressure range, 25 to 150 lb/in^2 nitrogen. NO_2 absorption originally noted has been shown to originate from the external atmosphere surrounding the flame. Absence of nitrogen dioxide from the fizz zone is highly significant with respect to theories of reaction mechanism, which usually assume as primary step the formation of nitrogen dioxide and a radical from a nitrate. The present demonstration indicates that formation of NO_2 is a secondary reaction. A.

535.33.07

6503. A METHOD OF INDICATING WAVE-NUMBERS IN SPECTRO-PHOTOMETRIC RECORDING. B.Å.Krantz and N.Åslund.
Ark. Fys., Vol. 10, Paper 15, 165-73 (1955).

An account is given of a method for indicating wave-number marks at constant intervals on a graphic recording of a spectrum. The wave-number marking is obtained by utilizing light interference. The marking is free of parallaxes, which has been attained by scanning the spectrum as well as the interference pattern with the same photo-multiplier and by using the same writing tool to record the spectrum and the marks. The signals from the photo-multiplier are separated by electronic means. The marks are obtained as thin vertical lines overlapping the spectrum. The method has been checked with the aid of a test apparatus, and the wave-numbers of some neon lines (discharge tube) have been measured. A prism-spectrograph has been used. The results prove that the same degree of accuracy is obtained with this method as with the conventional photographic method of measuring wave-number, when the same spectrograph is used, but the method described enables a more rapid calculation of the wave-numbers. Furthermore, it should be possible to develop the apparatus to be used in combination with a spectrograph of greater dispersion. A.

535.33.07

6504. SHRINKAGE EFFECT OF CLOSE COMPONENTS IN SPECTROSCOPIC INSTRUMENTS. M.S.Sodha.
Indian J. Phys., Vol. 29, No. 10, 461-7 (Oct., 1955).

Neglecting the Doppler width, the author has calculated the shift of maxima caused by mutual overlapping of intensity patterns of very close spectral lines for a number of spectroscopic instruments. A table, which may be used to correct for shrinkage effect has been given for a Fabry–Perot etalon. The value of the resolving power of a Fabry–Perot etalon according to Abbe's criterion has also been refined taking into account the shrinkage effect. A.

535.33.07

6505. REFLECTION IMAGE REDUCER. R.G.Greenler.
J. Opt. Soc. Amer., Vol. 46, No. 6, 433-4 (June, 1956).

A reflection image reducer is described which will demagnify an infrared image to match the small sensitive area of an infrared detector. Spherical surfaces are used in a manner which corrects for spherical aberration. The optics are used nearly on axis to minimize off-axis aberrations. A.

535.331

6506. THE FIRST SPECTRUM OF BARIUM, Ba I. H.N.Russell and C.E.Moore.
J. Res. Nat. Bur. Stand., Vol. 55, No. 6, 299-306 (Dec., 1955).

This paper has been prepared from existing references, to present unpublished analysis and, also, because Ba I is important in the history of atomic spectra. The first regularities attributed to two excited electrons were found in Ba I as well as in Ca I and Sr I. Three tables are included: A complete term list; a complete line list containing all observed and all classified lines; a table giving the estimated intensities of the observed combinations. There are approximately 390 classified lines. The limit, derived from well-established series, is 42032.4 K, giving an ionization potential of 5.210 V. A.

535.332

6507. ON THE SENSITIVE LINES EMITTED BY ATOMS AND IONS OF SOME ELEMENTS DIFFICULT TO DETECT BY SPECTROGRAPHIC ANALYSIS. G.Balloffet and J.Romand.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2333-5 (May 7, 1956). In French.

It is found that the most sensitive lines are s-p transitions of ions with a single electron in the outer shell. Wavelengths of such ions, excited by the sliding spark (Abstr. 8585/1955) are listed for C, N, O, Si, P, S, Cl, Ge, As and Se; they occur in the range 800-1500 A. G.F.Lothian

535.333 : 536.46

6508. SPECTROGRAPHIC EXAMINATION OF GASEOUS FLAMES AT HIGH PRESSURE. J. Diederichsen and H.G.Wolfhard.
Proc. Phys. Soc. A, Vol. 236, 89-103 (July 10, 1956).

Describes an investigation into the light emission of both premixed and diffusion flames burning at pressures up to 10 atm. It shows that the equipartitioning of energy released by chemical reaction is faster at high pressure. This leads to the suppression of unstable radicals which are observed in low-pressure flames. The total light intensity of flames burning with air is little pressure-dependent; however, continuous gas radiation and emission from carbon particles become predominant at higher pressures. The radiation of oxygen flames is mainly determined by the increase in temperature of flames burning at high pressure. This leads to a strong increase in the emission from those products which are present in equilibrium such as OH and O_2. Continuous gas radiation increases very strongly with pressure and two types of continua can readily be distinguished: the carbon monoxide flame continuum and the hydrogen flame continuum. The first continuum has been attributed by Gaydon to the process $CO + O \rightarrow CO_2 + h\nu$, and this is supported by the present investigation. It is proposed that the second continuum is due to the association $OH + OH \rightarrow H_2O_2 + h\nu$, and experimental evidence presented in this paper is in agreement with this. Continua occurring in hydrocarbon flames are a superposition of the two described above. This continuous gas radiation is responsible for most of the light emitted from high-pressure flames. A.

535.333

6509. ROTATIONAL ANALYSIS OF NO^+ BANDS. E.Miescher.
Helv. phys. Acta, Vol. 29, No. 2, 135-44 (1956). In German.

High dispersion spectra of NO^+ bands (1350-1650 A) have been obtained from a hollow cathode discharge as light source. Rotational analyses are given for seven bands of the $A^1\Pi$-$X^1\Sigma^+$ system and the following constants for NO^+ are determined: $X^1\Sigma^+$: $B_e = 2.002\ cm^{-1}$, $r_e = 1.0619$ A; $A^1\Pi$: $B_e = 1.587\ cm^{-1}$, $r_e = 1.1926$ A. From rotational perturbations observed in the $^1\Pi$-state a value $B = 1.251\ cm^{-1}$ for the perturbing $^3\Sigma^-$-state is derived. A.

535.333

6510. SOME RESULTS OF THE HIGH DISPERSION ELECTRONIC EMISSION SPECTRUM OF FORMALDEHYDE. G.W.Robinson.
Canad. J. Phys., Vol. 34, No. 7, 699-710 (July, 1956).

It has been possible to obtain the emission spectrum in the near ultraviolet region of formaldehyde in a discharge tube at sufficiently high resolution and purity so that the rotational structure can be studied. Some preliminary results of the analysis are discussed, especially with regard to the vibrational assignment of the emission and absorption systems and to the nature of the upper electronic state. An examination of the data rather strongly indicates a non-planar equilibrium configuration in the excited electronic state. Some of the previous interpretations are shown to be in disagreement with the experimental findings. A long path-length absorption study of the gas revealed a number of new bands, some of which may belong to a second electronic transition. A.

535.338.3

6511. THE INFLUENCE OF CERTAIN FACTORS IN THE MEASUREMENT OF THE MEAN LIFETIME OF THE MERCURY 6^3P_1 RESONANCE STATE BY THE MAGNETO-OPTIC METHOD. R.Lennuier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 18, 2230-2 (April 30, 1956). In French.

Briefly discusses the influence of experimental conditions on the observed lifetime. The vapour pressure, effect of foreign gas (A or Xe) when added to the Hg vapour, and the effect of the hyperfine structure of the exciting radiation are described. In conclusion, a mean lifetime of 1.07×10^{-7} sec is given. J.D.Craggs

535.338.332 : 538.222

MAGNETIC RESONANCE IN THE 7^3S_1 LEVEL OF MERCURY. See Abstr. 6016

535.338.334 : 523.872

THE DEBYE—HÜCKEL EFFECT AND STATISTICAL THEORIES FOR COLLISION BROADENING. See Abstr. 5648

535.338.41

6512. OBSERVATION OF TWO "SATELLITE" BANDS NEAR THE RESONANCE LINES OF POTASSIUM, UNDER PRESSURE OF ARGON UP TO 1200 ATMOSPHERES, AND OF MERCURY, UNDER PRESSURES OF ARGON AND NITROGEN REACHING 6000 ATM. J.Robin and B.Vodar.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2330-3 (May 7, 1956). In French.

The satellites, on the short-wave side, increase in intensity at increasing pressures. No theory is available. G.F.Lothian

535.34.07

6513. PRECISE MEASUREMENT OF WAVELENGTHS IN INFRARED SPECTRA. E.K.Plyler, L.R.Blaine and E.D.Tidwell.
J. Res. Nat. Bur. Stand., Vol. 55, No. 5, 279-84 (Nov., 1955).

The precise measurement of infrared absorption spectra has been accomplished by using the white-light fringes of a Fabry-Perot interferometer in conjunction with atomic spectral lines. Wavelengths from the first spectra of neon, argon, krypton, and xenon were used for calibrating the fringes. The absorption spectra and the fringe system are recorded simultaneously by a two-pen recorder. One pen records the higher orders of the fringe system of visible light as detected by a 1P28 photomultiplier. The other pen records the infrared absorption spectrum, which is detected by a PbTe cell. A measurement of the distance from the centre of the absorption line to the neighbouring maxima of the fringe system determines the line position to a high precision. Wavelengths of infrared lines can be measured with an error of one part in 500 000. Eight infrared lines of mercury, seventeen lines of krypton, and five lines of xenon have been measured by this method. Tables are given of visible and infrared lines of the noble gases, which are useful for calibration. A.

535.34.07 : 535.343

6514. CONTRIBUTION TO THE THEORETICAL AND EXPERIMENTAL STUDY OF THE FAR INFRARED. A.Hadni.
Ann. Phys. (Paris), Ser. 13, Vol. 1, 234-90 (March-April, 1956). In French.

Describes a grating spectrometer for use in the range 250-500 cm^{-1} with resolution about 1 cm^{-1}. Methods of reducing short-wave scattered radiation are discussed, including the use of a preliminary blazed grating in which the intensity of short-wave radiation is reduced in the zero-order beam. (A design to go as far as 125 cm^{-1} is discussed). Absorption curves are shown and discussed for acetaldehyde $(CH_3)_2O$, CCl_2F_2, CH_3OH, CS_2 and $(CH_3)_2CO$. Measured frequencies are used to calculate specific heats of C_2H_5OH and $(CH_3)_2O$ in fairly good agreement with thermal measurements; the height of the potential barrier preventing free rotation of the CH_3 group around a single bond is calculated from the measured torsional frequencies as 315 cm^{-1} in CH_3OH, 530 cm^{-1} in CH_3NH_2 and 1405 cm^{-1} in $(CH_3)_2O$. 95 refs. G.F.Lothian

535.34.07 : 539.152.2

6515. NUCLEAR INDUCTION SPECTROMETER FOR USE AT HIGH RF INTENSITIES AND LOW TEMPERATURES. A.G.Redfield.
Rev. sci. Instrum., Vol. 27, No. 4, 230-2 (April, 1956).

A nuclear induction spectrometer for the measurement of short relaxation times and the study of saturation and related phenomena is described. Radio-frequency intensities of up to 100 gauss are attainable from four to ten megacycles. Novel features of the apparatus are an r.f. head for use in a liquid helium cryostat, transmitter output level stabilization circuit, and a calibration circuit for comparing the intensity of the absorption at different r.f. levels. A.

535.34.07 : 539.152.2 : 536.581.3

6516. MULTIPLE TARGET NUCLEAR MAGNETIC RESONANCE CRYOSTAT. N.Fuschillo.
Rev. sci. Instrum., Vol. 27, No. 6, 394-6 (June, 1956).

A cryostat is described for accurately controlling the temperatures to 0.1 deg K of several solid specimens during nuclear magnetic resonance experiments in the temperature range from 10 to 400°K. The specimen targets are passed through the r.f. coil of the spectrometer in succession. This procedure enables more certain comparisons to be made of line shapes for different samples. The method is of particular advantage when small changes are to be observed or when it is of importance to have the individual specimens undergo thermal treatments as similar as possible. Also, since several samples can be studied in succession at any desired temperature a considerable saving of time is achieved. The cryostat is designed so that solid or liquid specimens can be utilized with a minimum of disturbance to existing adjustments. A.

535.34.07 : 538.222

6517. A DOUBLE MAGNETIC FIELD MODULATION PARAMAGNETIC RESONANCE SPECTROMETER. H.A.Buckmaster and H.E.D.Scovil.
Canad. J. Phys., Vol. 34, No. 7, 711-21 (July, 1956).

A high-sensitivity, wide or narrow band, double magnetic field modulation type paramagnetic resonance spectrometer operating at a wavelength of 1.25 cm for use at liquid helium temperatures (4°K) is described. The spectrometer employs a transmission type, cylindrical resonant cavity excited in the H_{111} mode. The magnetic field is modulated simultaneously at 60 c/s and 465 kc/s. A resonance from 10^{-11} mole of diphenyl trinitro phenyl hydrazyl has been observed with a signal-to-noise ratio of 2 : 1 at 290°K in wide band operation (8 kc/s) indicating that a sensitivity of $O(10^{-15})$ mole should be possible in narrow band operation (1 c/s) at 4°K because of its inherent high stability. A.

535.342 : 535.37

6518. ON THE ACTION OF NUCLEAR RADIATIONS ON THE OPTICAL PROPERTIES OF INORGANIC PHOSPHORS. F.Bandow.
Optik, Vol. 13, No. 6, 259-63 (1956). In German.

A brief review of the effects produced by α-particles and neutrons, including new absorption bands, new luminescent centres, and the destruction of fluorescence and phosphorescence. Other effects referred to are the change of rate in the rise and fall of luminescence, the occurrence of nonproportional response, the increase of quenching under infrared, and possible electroluminescent phenomena. S.T.Henderson

535.343

6519. ABSORPTION SPECTRUM OF FREE CH_3 AND CD_3 RADICALS. G.Herzberg and J.Shoosmith.
Canad. J. Phys., Vol. 34, No. 5, 523-5 (May, 1956).

In the flash photolysis of $Hg(CH_3)_2$ and other compounds strong diffuse (predissociated) absorption bands of CH_3 have been observed in the region 1510-1300 A, with a weaker band at 2160 A. Bands of CD_3, CH_2D and CHD_2 have also been observed. The band of CD_3 at 2140 A shows some rotational structure and the molecule is believed to be planar. The strong bands form a Rydberg series leading to an ionization potential of 9.840 eV. A.G.Gaydon

535.343

6520. ON THE ABSORPTION SPECTRUM OF THE VAPOUR OF WATER AND HEAVY WATER IN THE EXTREME ULTRAVIOLET. N.Astoin.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2327-9 (May 7, 1956). In French.

The spectrum of H_2O in the range 160-1100 A is shown on a curve, and consists of diffuse bands superposed on a continuum which shows several inflections. The latter are related to the several ionization potentials, but the bands are not discussed. The spectrum of D_2O is said to be similar. G.F.Lothian

535.343 : 539.89

6521. EXPERIMENTS ON THE DISPLACEMENT OF THE ULTRAVIOLET ABSORPTION EDGE OF OLIVINE AT HIGH PRESSURES. S.K.Runcorn.
J. appl. Phys., Vol. 27, No. 6, 598-602 (June, 1956).

The effect of pressure on the fundamental excitation energy of valence electrons in the ferromagnesium orthosilicate, the mineral olivine, is of interest in the theory of the electrical conductivity of the earth's mantle. The experimental determination of this by observation of the displacement of the ultraviolet absorption threshold of olivine up to pressures of about 30 000 bars is described. A.

535.343

6522. EFFECTS OF TEMPERATURE AND DENSITY ON THE ABSORPTION SPECTRUM IN THE MEDIUM ULTRAVIOLET OF LIQUID BENZENE. VARIATION OF THIS ABSORPTION SPECTRUM ON SOLIDIFICATION OF LIQUID BENZENE. B.Oksengorn.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2324-6 (May 7, 1956). In French.

The spectrum of the liquid shifts to longer wavelengths with increase of temperature or density. The results can be interpreted on the theory of Shuler (Abstr. 5617/1953). Curves show preliminary measurements of the shifts for liquid and solid at a range of melting points obtained under different pressures. G.F.Lothian

535.343

6523. ULTRAVIOLET ABSORPTION SPECTRA OF ORTHO- AND PARA-TOLUNITRILE IN VAPOUR, LIQUID AND SOLID STATES. S.K.Sen.
Indian J. Phys., Vol. 29, No. 12, 561-8 (Dec., 1955).

The absorption spectra of thin films of o- and p-tolunitrile in the liquid and the solid states at low temperatures have been studied and the results have been compared with those for the vapour state and for solutions of these substances. Absorption spectra of the substances in the vapour state have also been reinvestigated and the bands have been reclassified. In the liquid state o-tolunitrile gives five broad bands with the 0, 0 band at 35 055 cm^{-1}, while in the vapour state the 0,0 band is at 35 780 cm^{-1} and in the solid state at −180° C the bands become sharper and the 0,0 band shifts to 34 841 cm^{-1}. In the case of p-tolunitrile in the liquid phase seven broad bands are obtained with the 0,0 band at 35 771 cm^{-1}, while the 0,0 band due to the vapour is at 36 208 cm^{-1}. In the solid state the substance gives nine bands with the 0,0 band at 35 752 cm^{-1}. Thus major change in the bands occurs with the liquefaction of vapours, the 0,0 band shifting towards longer wavelength in both the cases. Such a shift may be due to association of molecules in the liquid state. With solidification and lowering of temperature to −180° C, the 0,0 band shifts further towards longer wavelengths in the case of ortho compound but no such change takes place in the case of the para compound. It is concluded that the shift observed with solidification of the ortho compound may be due to larger dipole moment of this molecule than that of the para compound. A.

535.343

6524. THE ULTRAVIOLET ABSORPTION SPECTRUM OF O-FLUORO-CHLORO-BENZENE. S.L.N.G.Krishnamachari.
Indian J. Phys., Vol. 29, No. 12, 603-4 (Dec., 1955).

Bands are observed with the vapour in the range 2400-2700A. Most of the bands could be interpreted on the basis of 8 ground state and 8 excited state frequencies, which are tabulated.

G.F.Lothian

535.343

6525. ON SOME NEW OBSERVATIONS CONCERNING THE SPECTRUM OF EXCITON LINES IN CuI. S.Nikitine, R.Reiss and G.Perny.
C.R. Acad. Sci. (Paris), Vol. 242, No. 21, 2540-2 (May 23, 1956). In French.

The absorption spectrum at liquid helium temperature varies with the nature of the film of CuI. Some lines are often obtained, others occasionally. Reflection and luminescence spectra at liquid nitrogen temperature are mentioned.

S.T.Henderson

535.343 : 539.132

6526. FINE STRUCTURE ANALYSIS AND MUTUAL PERTURBATION OF THE δ AND β BANDS OF THE NO MOLECULE. G.Herzberg, A.Lagerqvist and E.Miescher.
Canad. J. Phys., Vol. 34, No. 6, 622-4 (June, 1956).

The results are given of analyses of bands of the $B(^2\Pi)$, $C(^2\Pi) - X(^2\Pi)$ systems. Mutual perturbations between the B and C states have been followed in detail: these show very clearly the effects of the crossing of two potential energy curves. The crossing point is near $v = 15$ in B and $v = 3$ in C. Except near this point, the approximation in which a crossing occurs appears to be appropriate for the description of the vibrational levels. Levels in B have been followed as far as $v = 19$ at $\nu = 62\,590$ cm^{-1}. This state correlates with $N(^2D) + O(^3P)$ at 71 700 cm^{-1} above $X^2\Pi$ of NO, assuming that $D_0^0(NO) = 6.50$ eV.

R.F.Barrow

535.343 : 537.311.33

6527. CONCENTRATION EFFECTS ON THE LINE SPECTRA OF BOUND HOLES IN SILICON. R.Newman.
Phys. Rev., Vol. 103, No. 1, 103-6 (July 1, 1956).

The effect of impurity concentration on the line spectra of holes bound to B, Al and Ga acceptors in silicon has been studied at 21°K. Details of the spectra (i.e., relative positions, line shapes, intensities) differ for the different acceptors. Below an acceptor concentration of about 10^{16}/cm^3 the spectra are concentration-independent under the conditions of measurement. Above 10^{16}/cm^3 the spectral lines begin to broaden and by $\sim 10^{18}$/cm^3 the line structure has been almost completely destroyed. A qualitative discussion of the concentration effects is given.

A.

535.345

6528. THE ABSORPTION EDGE OF AMORPHOUS SELENIUM AND ITS CHANGE WITH TEMPERATURE. C.Hilsum.
Proc. Phys. Soc. B, Vol. 69, Pt 5, 506-12 (May, 1956).

Measurements have been made in the region from 0.58 to 0.66 microns. The effect of temperature on the absorption edge has also been determined, and the edge is shown to shift by 2.7 A deg^{-1}, equivalent to a change in the energy gap of 9.7×10^{-4} eV deg^{-1}.

A.

535.347 : 541.64

6529. QUANTITATIVE INTERPRETATION OF INFRA-RED DICHROISM IN PARTLY ORIENTED POLYMERS. M.Beer.
Proc. Roy. Soc. A, Vol. 236, 136-40 (July 10, 1956).

It is shown that, subject to certain mild restrictions, the dichroism of a partly oriented polymer sample is the same as that of a fully alined plus an entirely random portion. If the directions of three linearly independent dipole moment vectors associated with different bands can be determined relative to the repeating unit of the polymer, then using the dichroism of the bands, the degree of orientation can be eliminated as a parameter and the inclination of the repeating unit relative to the polymer axis can be determined. Graphs are provided to aid in testing structures.

A.

535.37

6530. SELF-DEPOLARIZATION AND DECAY OF PHOTOLUMINESCENCE OF SOLUTIONS. A.Jabłoński.
Acta phys. Polon., Vol. 14, No. 4, 295-307 (1955).

Self-depolarization of photoluminescence of solid solutions (depolarization by migration of the excitation energy from one luminescent molecule to other luminescent molecules of the same kind) is treated in a similar way as the quenching of photoluminescence of solutions was treated in a previous paper (Abstr. 854/1955). The problem is, however, even more complicated than that of quenching, and thus some additional simplifying assumptions have to be made. The model of a luminescent centre adopted here is the simplest one. The excited centre is assumed to consist of an excited luminescent molecule surrounded by an "active sphere", which may contain one or more unexcited luminescent molecules of the same kind. If there are unexcited molecules within the active sphere, the excitation energy can be transferred to them and migrate several times from one molecule to another. The probability of an energy transfer is assumed to be proportional to time and be the same for transfer to any of the unexcited molecules belonging to the same centre. It is assumed to be nil for transfer to unexcited molecules outside the centre. All the centres of a system (i.e. in our case, of a solid solution) are divided in groups according to the number of unexcited (depolarizing) molecules belonging to a centre — a centre is ascribed to the group k if it consists of one excited and k–1 unexcited molecules. Expressions are derived for the probability as a function of time of finding the excitation energy with a molecule primarily excited by absorption of light. These expressions are different for different groups of centres. Expressions are obtained: (i) for the decay of the particular components of photoluminescence, and (ii) for the degree of depolarization (or that of polarization) as a function of the concentration of luminescent molecules. The latter expression is compared with an experimental curve published by Chauchois.

A.

535.37

6531. TEMPERATURE DEPENDENCE OF THE FLUORESCENT YIELDS OF PTHALIMIDE DERIVATIVES. V.V.Zelinskii and B.P.Kolobkov.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 6, 1042-5 (1956). In Russian.

Investigations were carried out in a large number of different solvents and in plastics. Graphs and tables of results are given. The general course of behaviour is a region of constant efficiency below a certain temperature (–200°C to –120°C) followed by a gradual drop to a much lower value at temperatures approaching 0°C. There is a provisional discussion of the results but details of the methods and a full discussion are reserved for a later paper.

J.Ewles

535.37

6532. VAVILOV'S LAW. B.I.Stepanov.
Uspekhi fiz. Nauk, Vol. 58, No. 1, 3-36 (1956). In Russian.

The paper gives a historical development of the law of luminescent emission due to S.I.Vavilov. Thereafter it discusses quantum output of luminescence, the luminescent output of a system of particles with three energy levels, negative luminescence, relation between the quantum output of fluorescence from vapours and the wavelength of the exciting radiation, effect of foreign gases on the foregoing, and extra-molecular mechanism of anti-Stokes fluorescence.

C.R.S.Manders

535.37 : 539.13

6533. INTERMOLECULAR TRANSFER OF ENERGY IN THE PHENOMENON OF SENSITIZED LUMINESCENCE OF ORGANIC SYSTEMS. II. A.N.Terenin and V.L.Ermolaev.

Uspekhi fiz. Nauk, Vol. 58, No. 1, 37-68 (1956). In Russian.

For Pt I see Uspekki fiz. Nauk, Vol. 43, 347-78 (1951). The topic is of interest in connection with the possibility of energy transfer in photo-reactions of complex organic molecules. The paper discusses fluorescence in vapours of organic compounds, liquid solutions and biological subjects, transfer of excitation energy in molecular crystals, transfer of energy in heterogeneous systems and molecular complexes, excitation of a triplet level. 57 refs. C.R.S.Manders

535.37 : 548.7

6534. POLARIZED LUMINESCENCE OF CUBIC CRYSTALS. P.P.Feofilov.

Uspekhi fiz. Nauk, Vol. 58, No. 1, 69-84 (1956). In Russian.

A survey of the author's work which discusses the orientation of luminescent centres in cubic crystals, anisotropic photochemical processes in such crystals, polarization of the luminescence in cubic crystals and the nature of the elementary oscillators. C.R.S.Manders

535.371

6535. ON THE EXCITATION EFFICIENCY FOR RED AND GREEN LUMINESCENCE OF CADMIUM SULPHIDE CRYSTALS. E.Waibel.

Ann. Phys. (Leipzig), Vol. 17, No. 6-8, 389-400 (1956). In German.

The quantum yield of fluorescence is measured for intense Hg line excitation between 0.365 μ and 0.578 μ wavelengths and for micro and single crystal specimens. Transmission and reflection spectra for the latter yield the absorption coefficient. At 90° K for the green emission a quantum efficiency of 0.2 is found and for the red emission a value of 0.4 is obtained. G.F.J.Garlick

535.371

6536. THE ENHANCEMENT OF THE FLUORESCENCE OF VAPOURS. E.J.Bowen and S.Veljković.

Proc. Roy. Soc. A., Vol. 236, 1-6 (July 10, 1956).

The quantum yield of fluorescence from the vapour of perylene is shown to be increased when various gases are present. The effect is interpreted in terms of the removal of excess energy from the excited molecules, and its relation to molecular weight and structure is discussed. A.

535.375.51

6537. INTENSITIES IN THE RAMAN SPECTRUM OF BENZENE. D.H.Whiffen.

Proc. Phys. Soc. A, Vol. 69, Pt 5, 375-80 (May, 1956).

The photoelectrically measured intensities and depolarization ratios of the Raman lines of liquid benzene, hexadeuterobenzene and sym.-trideuterobenzene are interpreted in terms of the normal coordinates and the polarizability gradients. Preferred choices are indicated, where sign ambiguities lead to alternative solutions, and the polarizability gradients are: $\partial\alpha_{XX}/\partial S_1 = +6.7\,A^2$, $\partial\alpha_{ZZ}/\partial S_1 = +1.9\,A^2$, $\partial\alpha_{XX}/\partial S_2 = +4.7\,A^2$, $\partial\alpha_{ZZ}/\partial S_2 = +0.3\,A^2$, $\partial\alpha_{XX}/\partial S_{6a} = +1.16\,A^2$, $\partial\alpha_{XX}/\partial S_{7a} = +1.17\,A^2$, $\partial\alpha_{XX}/\partial S_{8a} = -1.14\,A^2$, $\partial\alpha_{XX}/\partial S_{9a} = +0.25\,A^2$, $\partial\alpha_{X^*Z^*}/\partial\alpha_{10a} = +0.050\,A^2$. Tables show the agreement between experiment and calculation. Bond polarizability gradients are deduced and the reasons for incomplete agreement are discussed. A.

535.375.54

6538. RAMAN SPECTRA OF FROZEN SOLUTIONS OF CARBON DISULPHIDE IN ALIPHATIC SOLVENTS. G.S.Kastha.

Indian J. Phys., Vol. 29, No. 10, 474-8 (Oct., 1955).

The Raman spectra of frozen solutions of carbon disulphide in methyl cyclohexane of strengths 62.3%, 52.4% and 45.2%, in methyl alcohol of strengths 34.6% and 24.1% and in carbon tetrachloride of strength 20.8% have been investigated at −180° C. In all the cases, except in the case of the solution in methyl cyclohexane of strength 45.2%, the new lines 70 cm^{-1} and 81 cm^{-1} have been observed as in the case of pure carbon disulphide. These lines, however, disappear when the streng of the solution of carbon disulphide in methyl cyclohexane is diminished to 45.2%. It has been pointed out from the conside ations of the densities of the solute and the solvents that the new lines cannot be due to angular oscillations of the molecul in the lattice of pure carbon disulphide. It has, therefore, been concluded that these lines originate from the vibrations dimers or slightly larger groups of carbon disulphide molecules present in the pure liquid or in the solutions mentioned above except in 45.2% solution in methyl cyclohexane. A

535.375.5

6539. RAMAN SPECTRA OF A FEW MONOSUBSTITUTED BENZENE COMPOUNDS IN THE SOLID STATE AT DIFFERENT LOW TEMPERATURES. D.C.Biswas.

Indian J. Phys., Vol. 29, No. 11, 503-17 (Nov., 1955).

The results of the investigations on the Raman spectra of C_6H_5 Br, $C_6H_5OCH_3$, C_6H_5 $COOCH_3$ and $C_6H_5COOC_2H_5$ in the liquid state and in the solid state at different low temperature have been discussed. The Raman spectrum of C_6H_5Cl in the vapour state has also been reinvestigated. Attempts have bee made to assign some of the lines due to bromobenzene. The number of new low-frequency lines observed in the spectra of these four compounds in the solid state is different for the different compounds. Ethyl benzoate gives only one weak line at 96 cm^{-1} at −180° C, while methyl benzoate yields two stron lines. In the case of anisole and methyl benzoate the intensity of some of these lines increases at the lower temperature. Two broad fluorescence bands have been observed in each of the spectra due to bromobenzene and methyl benzoate in the solid state at −180° C. The frequency difference is about 1590 cm^{-1} in both the cases. These are ascribed to distortion of the benzene ring at −180° C. A

535.37

6540. ELECTROPHOTOLUMINESCENCE EFFECTS. F.Matossi and S.Nudelman.

J. Electrochem. Soc., Vol. 103, No. 2, 122-7 (Feb., 1956).

Various electrophotoluminescence effects of phosphors continuously excited by ultraviolet radiation were studied for their dependence on field strength and frequency. These effects include luminescence stimulations at application and removal of alternating electric fields, quenching, and a perio ic fluctuation of luminescence (ripple) during the field applica tion. For some electroluminescent phosphors, the gradual transition from the quenching ripple to the electroluminescen brightness wave was observed, indicating that the brightness waves and the ripple patterns are produced by independent processes. The observations are discussed in the light of previous theoretical considerations. A

535.37

6541. THE EFFECT OF ELECTRON TRAPS ON ELECTR LUMINESCENCE. P.D.Johnson, W.W.Piper and F.E.Willian

J. Electrochem. Soc., Vol. 103, No. 4, 221-4 (April, 1956).

Measurements of the temperature dependence of electroluminescent brightness and thermoluminescence of phosphor powder suspensions in Lucite and of single crystals demonstrate that electroluminescent brightness can be affected by electron traps. At low temperatures traps may, by field ionization, supply electrons in the region of high field. At highe temperatures they are thermally emptied, enhancing the field in the barrier region. Decreases in electroluminescent brigh ness occur in the temperature range where the role of traps i changing. A

535.37

6542. ELECTROLUMINESCENCE AND THERMOLUMINESCENCE OF ZnS SINGLE CRYSTALS. G.F.Neumark.

Phys. Rev., Vol. 103, No. 1, 41-6 (July 1, 1956).

Electroluminescence, thermoluminescence and thermoluminescence under an applied voltage have been studied in ZnS single crystals. For electroluminescent crystals, the

application of a constant electric field during thermoluminescence generally increases the intensity of the emitted light over the sum of the intensities due to the thermoluminescence and to the electroluminescence separately. A similar effect was observed during phosphorescence and during infrared stimulation. No such effects were observed on non-electroluminescent crystals. It was also found that an electric field can fill electron traps, but field emptying of traps did not appear to be important. The current during the electroluminescence and during the thermoluminescence was measured simultaneously with the light emission. There was little correlation between current and thermoluminescence, but quite good correlation between current and the additional light resulting from a constant voltage during the thermoluminescence. These results suggest that some of the electrons released from traps contribute to the current and can cause impact excitation or ionization, but that others are not effective in this. Since both the current and the additional light are considerably higher during the high-temperature glow peak than during the low-temperature one, it appears that the electrons released from the deeper traps are more effective in these processes than those released from the shallower traps. A.

535.39

6543. VARIATIONAL METHOD FOR THE CALCULATION OF THE DISTRIBUTION OF ENERGY REFLECTED FROM A PERIODIC SURFACE. I. W.C.Meecham.
J. appl. Phys., Vol. 27, No. 4, 361-8 (April, 1956).

A variational method is presented which is used to calculate the energy appearing in the various diffracted orders set up when a plane wave is incident upon a periodic reflecting surface. Either the first or the second boundary condition can be so treated. A sample problem is worked showing that if the average absolute slope of the reflecting surface is small (segments of surface with large slope may be included) and if the displacement of the surface is not large compared with the wavelength of the incident radiation, the formulation gives results correct to within a few %. The calculation shows the existence of Wood anomalies; these are discussed in the paper. A.

535.39 : 539.234

6544. THE INFLUENCE OF DISPERSION ON THE OPTICAL DETERMINATION OF THE THICKNESS OF THIN FILMS. G.Koppelmann and K.Krebs.
Z. Phys., Vol. 145, No. 4, 486-95 (1956). In Russian.

The dispersion in reflectivity measurements of vacuum-evaporated ZnS films was determined and the effect of the dispersion on the thickness determination was investigated theoretically and experimentally. The results are expected to hold in general for any thin film showing interference effects. C.A.Hogarth

535.393 : 539.23

6545. PRESENT STATE OF THE THEORY OF THE OPTICAL PROPERTIES OF SEMI-TRANSPARENT METAL COVERINGS. G.V.Rozenberg.
Uspekhi fiz. Nauk, Vol. 58, No. 3, 487-518 (1956). In Russian.

Review dealing with the structure of those layers and the resulting effective parameters, the Maxwell-Garnett theory, optical properties of a colloidal covering, monomolecular layers. 32 refs. C.R.S.Manders

535.435

6546. DEPOLARIZATION AND INTENSITY OF LIGHT SCATTERED BY LIQUIDS WITH ANISOTROPIC MOLECULES. J.A.Prins and W.Prins.
Physica, Vol. 22, No. 7, 576-8 (July, 1956). In French.

It is shown that the classical Cabannes factor in light scattering holds good for a liquid model where a correlation in orientation between neighbouring molecules exists. A.

535.43 : 535.36

6547. RADIATIVE TRANSFER WITH CENTRAL SOURCES OF NON-UNIFORM DIRECTIONAL INTENSITY. J.T.Jefferies.
Proc. Phys. Soc. B, Vol. 69, Pt 5, 577-82 (May, 1956).

Approximate expressions are obtained for the total intensity in a spherically or cylindrically symmetric diffuser containing respectively a point or a line source centrally placed, the source emitting with an arbitrary directional dependence. Results are given for homogeneous media and for simple cases of composite media. See also Abstr. 271 (1956). A.

535.51

6548. A NOTE ON THE POLARIZATION DUE TO OBLIQUE REFLEXION AT AN ALUMINIZED OR SILVERED MIRROR. J.N.Hodgson.
Brit. J. appl. Phys., Vol. 7, No. 6, 229-30 (June, 1956).

An approximate formula giving the degree of polarization P in terms of the normal reflectivity R_0 and the angle of incidence θ is derived. It is $P \cong \frac{1}{2}(1 - R_0) \sin\theta \tan\theta$ and gives results accurate to within 10% in the visible spectrum when $\theta \leq 45^\circ$. H.G.Jerrard

535.51

6549. COMPOSITE QUARTER- AND HALF-WAVE PLATES. W.H.J.Childs.
J. sci. Instrum., Vol. 33, No. 8, 298-301 (Aug., 1956).

It is well known that, within certain limits, a quarter-wave plate may be made from two suitably oriented cellophane sheets. An attempt to construct such composite plates showed up some of their interesting peculiarities. These are discussed in the present paper, which also gives constructional details of quarter- and half-wave plates and extends the theory to include two- and three-component wave plates of any delay. General expressions are developed to cover all these cases; in the case of triple-sheet combinations it is shown that it is possible to neutralize the rotation of axes which is unavoidable with two-component plates and to produce composite plates having all the properties of simple plates. To assist the design and assembly of composite plates, tables of constructional constants for double and triple quarter-wave plates, and triple half-wave plates are included. A.

535.514.9 : 523.161

INTERSTELLAR POLARIZATION OF LIGHT. See Abstr. 5612

535.55

6550. THE SUITABILITY OF ARALDITE D RESIN IN PHOTOELASTIC INVESTIGATIONS. C.L.Amba Rao.
Brit. J. appl. Phys., Vol. 7, No. 6, 229 (June, 1956).

The stress-optical properties of this resin for different percentages of hardener are given. It is pointed out that this resin can be cast without heat, is suitable for three-dimensional work, has a linear stress-birefringence curve, has no prominent creep and is easily machined. Young's modulus varies from 3.75×10^5 to 2.70×10^5 lb.in^{-2} according to the amount of hardener present, and has a corresponding fringe constant varying from 65 to 33 lb.in^{-2} tension per in. per fringe. H.G.Jerrard

535.557

6551. DYNAMIC DOUBLE REFRACTION IN SOLUTIONS OF HIGH MOLECULAR WEIGHT POLYSTYRENE. V.N.Tsvetkov and S.M.Savvon.
Zh. tekh. Fiz., Vol. 26, No. 2, 348-58 (1956). In Russian.

535.563 : 538.614

6552. FARADAY EFFECT IN GASES AND VAPORS. II. L.R.Ingersoll and D.H.Liebenberg.
J. Opt. Soc. Amer., Vol. 46, No. 7, 538-42 (July, 1956).

For Pt I see Abstr. 9418 (1954). Continuing the work reported in Pt I, Verdet constants have been measured over the spectral range 3635 A to 9875 A for 15 more gases. These

include 3 noble gases, 7 hydrocarbons and 5 other gases. For comparison purposes and also because of a 1% error in the original measurements, the 7 gases first reported on are also listed here. Save in the case of exygen, the dispersion curves do not differ greatly from the inverse-square-of-the-wavelength law, the largest departure being shown by xenon, carbon monoxide, acetylene and ethylene. The Verdet values for about half the gases fit either the modified Becquerel equation or the Serber equation, neon showing somewhat less agreement than the others. Oxygen remains a notable exception, whose Faraday dispersion cannot yet be satisfactorily explained by theory. A.

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.81 : 517.512.2

OPTICAL FOURIER SYNTHESIZER. See Abstr. 5595

HEAT 536

536.2.02

6553. CONDUCTION OF HEAT IN AN INFINITE REGION BOUNDED INTERNALLY BY A CIRCULAR CYLINDER OF A PERFECT CONDUCTOR. J.C.Jaeger.
Austral. J. Phys., Vol. 9, No. 2, 167-79 (June, 1956).

Numerical information is given for radial flow of heat in an infinite region bounded internally by a circular cylinder of radius a containing a perfect conductor, there being contact resistance 1/H per unit area across the cylinder. Problems considered are: (i) the perfect conductor and the surrounding region initially at different temperatures; (ii) heat supply to the perfect conductor. Results are expressed in terms of the dimensionless parameters $\tau = \kappa t/a^2$, $h = K/aH$, $\alpha = 2\pi a^2 \rho c/S$, where K, ρ, c, κ are the thermal conductivity, density, specific heat, and diffusivity in the region outside the cylinder, S is the thermal capacity of the perfect conductor per unit length of the cylinder, and t is the time. Tables and graphs of the temperature of the perfect conductor are given for $0.2 < \tau < 20$; h = 0, 0.5, 1, 2, 3, 4, 5, 7, 10, 20; and α = 0.5, 1, 1.5, 2. The temperature outside the cylinder, a problem involving fluid motion within the cylinder, and the heating of a buried cable carrying electric current are also discussed. A.

536.212.2.01

6554. ON THE THEORY OF THERMAL CONDUCTIVITY OF MONOVALENT METALS. T.Kasuya.
Progr. theor. Phys., Vol. 13, No. 6, 561-70 (June, 1955).

Sondheimer's theory of thermal conductivity conflicts in two points with experimental results: (i) the theoretical values of the conductivity at low temperatures are too small compared with experimental values, (ii) at intermediate temperatures the theory predicts the existence of a minimum of the conductivity which is not observed. Sondheimer's theory is criticized on several points, and considering only the problem of thermal conductivity, satisfactory results are obtained on a new basis. The main results are as follows: (1) Bloch's hypothesis that the phonon system is in thermal equilibrium in all temperature regions is applicable in the case of thermal conductivity. (2) Sondheimer solved Bloch equation by expanding $C(\epsilon)$ in a power series of ϵ, but this type of function does not give a correct solution in the case of the second-order phenomena. By using a more reasonable variation function, a more correct lower limit of thermal conductivity is obtained, which is about 20% larger than Klemens' result. Further an upper bound is obtained by a certain method and thus the bounds of the correct solution are determined. (3) By considering the exchange field and the correlation field, it is shown that the method of self-consistent field gives fairly large resistivity at high temperatures. The ratio C/ζ becomes 1.22. By this effect, the theoretical values of thermal conductivity become more consistent with experimental values, and the minimum of the conductivity at intermediate temperatures disappears. (4) Debye temperature determined by comparing with experimental values agrees very well with the Debye temperature of longitudinal sound waves calculated by Toya. A

536.212.2 : 537.311.31

6555. THERMAL AND ELECTRICAL CONDUCTIVITIES OF IRON, NICKEL, TITANIUM, AND ZIRCONIUM AT LOW TEMPERATURES. W.R.G.Kemp, P.G.Klemens and G.K.White.
Austral. J. Phys., Vol. 9, No. 2, 180-8 (June, 1956).

Measurements are reported of conductivities down to 2°K These indicate that thermal conduction in pure iron and nickel is almost completely electronic. Titanium and zirconium exhibit an appreciable lattice component of thermal conduction In the case of titanium this lattice component varies as $T^{1.5}$. The ideal electronic thermal resistivity below about 50°K was found to be $10 \times 10^{-5}\ T^{2.2}$ and $11 \times 10^{-5}\ T^2$ cm.deg.W^{-1} for iron and nickel respectively. The ideal electrical resistivity was found to vary as T^3 at low temperatures for all four metals. A

536.23 : 539.13

6556. THERMAL CONDUCTIVITY AND FORCE BETWEEN LIKE MOLECULES. S.C.Saxena.
Indian J. Phys., Vol. 29, No. 12, 587-602 (Dec., 1955).

The Chapman–Enskog kinetic theory of non-uniform gases as applied to the phenomenon of thermal conductivity, has been utilized to evaluate the intermolecular force constants, by assuming the Lennard-Jones 12 : 6 interaction potential for inert gas molecules. The temperature variation of thermal conductivity gives the force constant ϵ of the Lennard-Jones function, while r_0 is found by actual substitution. To test the adequacy of the model the transport coefficients have been calculated by utilizing these potential parameters, and compared with the observed values over an extensive range of temperatures. It is found that the agreement between theory and experiment is quite satisfactory showing thereby the adequacy of the 12 : 6 model and correctness of the values assigned to the force constants. The important quantity $\lambda/\eta c_v$ has been calculated theoretically for various temperatures and pressures and is found to vary only slightly with temperature but considerably with pressure. The Enskog theory of dense gases has been applied to the particular case of argon and the results compared with the observed values. A.

536.253

6557. INFLUENCE OF THE METAL/GAS INTERFACE ON THE CONVECTION FROM FINE WIRES. I.Epelboin, D.H.Pham and A.Vapaille.
Ann. Phys. (Paris), Ser. 13, Vol. 1, 207-33 (March-April, 1956). In French.

The theory of measurement of heat and end losses from thin wires is given. The experimental details are given briefly and the results are expressed in terms of Nusselt, Prandtl and Grashof numbers in both tabular and graphical form. It is shown that the metal and the gas considerably affect the heat loss by convection and possible explanations are indicated. E.H.Dock

536.413 : 548

6558. THERMAL EXPANSION OF DIAMOND. J.Thewlis and A.R.Davey.
Phil. Mag. (Ser. 8), Vol. 1, No. 5, 409-14 (May, 1956).

X-ray measurements are reported of the thermal expansion of industrial and gem-quality diamond from −150°C to +950°C. It is found that the thermal expansion of industrial diamond shows an anomaly at low temperatures. No such anomaly is found for gem-quality diamond for which Grün-

eisen's law holds in general throughout the range. The values of the unit-cell dimension at 20° C are: industrial diamond, a_0 = 3.5669$_2$ A, gem-quality diamond, a_0 = 3.56684 A. A.

536.421.1

6559. PROBLEM OF INTENSE SURFACE HEATING OF A SLAB ACCOMPANIED BY CHANGE OF PHASE. J.I.Masters.
J. appl. Phys., Vol. 27, No. 5, 477-85 (May, 1956).

In an attempt to bound the problem, steady-state solutions are obtained for the speed of surface recession (melting) and the internal temperature history of a slab which uniformly absorbs heat on one face at a large caloric rate. The solutions are found to be sensitive to assumptions that must be made regarding both the thickness attained by the layer of molten matter produced during the heat pulse and the mechanisms (e.g., air drag, evaporation) that control this thickness. A.

536.422

6560. THE STUDY OF SUBLIMATION OF Ag USING RADIOACTIVE INDICATORS AND A MASS-SPECTROMETER.
Yu.V.Kornev and E.Z.Vintaikin.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 5, 661-3 (1956). In Russian.

Measurements were carried out on Ag and on a gold alloy containing 30 atomic percent Ag. Ag^{110} and a mass-spectrometer were used to measure the vapour pressure of Ag and analyse the vapour phase. At 994° K and 1229° K the vapour pressure of pure Ag was 3.32 x 10^{-6} mm Hg and 2.32 x 10^{-3} mm Hg respectively, and for the alloy at 1020° K and 1153° K it was 1.16 x 10^{-6} mm Hg and 5.74 x 10^{-5} mm Hg respectively. The temperature dependence of the vapour pressure for pure Ag was found to be $\log p_{mm} = -68100/2.303\ RT + 9.465$ and for the alloy $\log p_{mm} = -69800/2.303\ RT + 8.993$. The heat of sublimation for Ag was found to be 68 kcal. The sublimation goes through a monatomic vapour phase. The alloy shows characteristics of a solid solution. M.Ebert

536.48

6561. ZERO VIBRATIONAL ENERGY OF CHAINS AND LAYERS AND THE HEAT CAPACITY. L.M.Tarasova and V.V.Tarasov.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 5, 719-22 (1956). In Russian.

Equations are deduced for the zero vibrational energy of [polymer]chain and layered [lattice] structures, and are discussed in relation to the heat capacity of cadmium iodide, which it is deduced should be proportional to the square of the absolute temperature not at the temperature of liquid hydrogen, but that of liquid helium. R.C.Murray

536.48 : 532.51

6562. ON THE ENERGY SPECTRUM IN QUANTUM HYDRODYNAMICS AND THE THEORY OF HELIUM II. A.Thellung.
Helv. phys. Acta, Vol. 29, No. 2, 102-27 (1956).

The eigenvalue spectrum of the quantum-mechanical Hamiltonian of non-viscous fluids is calculated in the approximation of large sound velocity and for low densities of phonons and rotons. The anharmonic potential energy in the Hamiltonian has no influence on the roton energies in the approximation considered; all contributions due to the term $\sim (\rho - \rho_0)^3$ cancel and the term $\sim (\rho - \rho_0)^4$ only gives rise to a renormalization of the sound velocity. Several procedures to cut off large wave-numbers are discussed. They lead to different results, but they all yield positive rest energies of the rotons and, when applied to He II, energy spectra of the right form and order of magnitude to fit the experimental data on specific heat up to temperatures near the λ-point. A.

536.48 : 536.5.081.4

6563. AN EXAMINATION OF THE HELIUM VAPOR-PRESSURE SCALE OF TEMPERATURE USING A MAGNETIC THERMOMETER. E.Ambler and R.P.Hudson.
J. Res. Nat. Bur. Stand., Vol. 56, No. 2, 99-104 (Feb., 1956).

The variation of the mutual inductance of two coils surrounding a paramagnetic crystal has been measured as a function of the saturation vapour pressure of helium in the range 1.3° to 4.2° K. The fact that this quantity should vary inversely as the absolute temperature has been made use of to investigate the consistency of two recently proposed vapour-pressure temperature scales. The results suggest errors above 2° K in the empirical equation proposed by Clement, Logan, and Gaffney (in contrast to the experiences of Erickson and Roberts with a magnetic thermometer) and are in closer accord with the thermodynamic calculation of Van Dijk and Durieux. A.

536.48

6564. TENSILE STRENGTH OF LIQUID HELIUM II.
A.D.Misener and G.R.Hébert.
Nature (London), Vol. 177, 946-7 (May 19, 1956).

An apparatus is described in which a liquid column is isothermally subjected to a negative pressure which is gradually increased. The breaking point can be observed. Preliminary measurements with nitrogen between 64 and 76° K show a strength of approximately 3.5 atm. Measurements with liquid helium between 1.09 and 2.15° K do not show any possibility of subjecting the liquid to negative pressure; it is concluded that the tensile strength cannot be larger than 0.3 atm. The experimental values for the tensile strengths are by far smaller than any theoretical estimate. R.Eisenschitz

536.48

6565. REVERSIBLE FLOW PHENOMENA AND THERMODYNAMIC PROPERTIES OF LIQUID HELIUM AND THE TWO-FLUID HYPOTHESIS. O.K.Rice.
Phys. Rev., Vol. 103, No. 2, 267-74 (July 15, 1956).

The terms superfluid and normal fluid may be interpreted in various ways, and in Landau's theory the fraction of normal fluid given by flow experiments (e.g., second sound) is not a direct measure of the number of atoms involved in the excitations. Furthermore, the anomaly in the specific heat above the λ point indicates the continued existence of unexcited material above the λ point, probably in the form of (nonspherical) droplets or clusters, which does not actually contribute to the superfluidity. These rather complex relationships are considered in the introduction, and it is concluded that, in spite of the various possibilities of choosing the two components for the two-fluid theory, any pair can be considered as thermodynamic components. It is also concluded that it is probable that the normal fluid and superfluid are separated in ordinary space as well as momentum space. There follows a discussion of the equation for second sound, and a comparison of the values for x (mole fraction of normal fluid) obtained from second sound and from the Andronikashvili experiment. The values of z are also discussed in connection with the values of the roton part of the specific heat, c_r. It is shown that these are difficult to reconcile from a thermodynamic point of view on the basis of any of the usual theories, and it may be necessary to reinterpret the equation for second sound in the region where both phonon and roton excitations are of importance. At higher temperatures the apparent anomalies, and especially the rapid rise of c_r/x near the λ point, are readily explained with the aid of the unexcited droplets mentioned above. Finally a critical analysis is made of the assumption, inherent in the second-sound equation, that entropy is carried only by normal fluid and not by the superfluid, which is in apparent contradiction with the fact that the entropy of mixing of superfluid and normal fluid cannot be zero if they are separated in ordinary space. It is shown from two points of view that there is no actual contradiction. In the first procedure a pressure is introduced which arises from the forces tending to separate normal and superfluid, and the accompanying work is considered. It is shown that this pressure must be considered to reside in the superfluid. The second procedure starts directly with the energy equation. It is shown that H.London's equation for the fountain pressure follows directly. A.

536.48

6566. THE FOUNTAIN EFFECT OF LIQUID HELIUM BELOW 1° K. G.J.C.Bots and C.J.Gorter.
Physica, Vol. 22, No. 6, 503-8 (June, 1956).

Measurements have been made on the fountain effect of liquid helium II below 1° K making use of magnetic cooling of a paramagnetic sample. The results are compared with theoretical values derived from H.London's formula, making use of data on the specific heat and the velocity of sound. The agreement is good down to 0.75° K, but below that temperature the experimental values are systematically somewhat lower. The differences are much smaller than those found in a preliminary investigation (Abstr. 6728/1953). A.

536.48

6567. ON THE BOSE–EINSTEIN LIQUID MODEL FOR LIQUID HELIUM. IV. A REVISED MODEL. Z.Mikura.
Progr. theor. Phys., Vol. 14, No. 4, 337-50 (Oct., 1955).

Fort Pt III, see Abstr. 11010/1954. The discrepancies between the modified Bose–Einstein theory developed in previous papers and some experimental facts are ascribed partly to the erroneous experimental results concerning the lambda-temperature shifts in mixtures, on which the theory was based, and partly to the inapplicability of an ideal gas model to pure liquid He^3. According to the recent experiments on the lambda-temperature shifts, the energy gap must be taken as proportional to the 0.4 th power of the number density of He^4 "particles", instead of as proportional to the number density. It is also shown that the above relation between the energy gap and the number density is applicable not only for the mixture problem but also for the high pressure effect. In particular, the thermal expansion of liquid He^4 calculated on the present model is found to be negative and of the right order of magnitude. Application of a similar model for liquid He^3 predicts a fall with pressure of the Fermi–Dirac degeneracy temperature while the usual ideal gas model predicts an increase with pressure. A.

536.48

6568. THE SURFACE ENERGY ASSOCIATED WITH A TANGENTIAL VELOCITY DISCONTINUITY IN HELIUM II. V.L.Ginsburg.
Zh. éksper. teor. Fiz., Vol. 29, No. 2(8), 254-6 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 170-2 (Jan., 1956).

The author assumes that the superfluid component of helium II shows a discontinuity of tangential velocity in the vicinity of the walls, even during steady flow. The discontinuity is stable if the velocity of flow is lower than the critical velocity. It requires energy to set up (but not to maintain) the discontinuity; this energy is proportional to the area over which the discontinuity of velocity extends. The order of magnitude of the energy required has been derived by fairly elementary arguments. This energy should show in flow experiments, in particular in flow through narrow slits. By taking account of this energy various discrepancies between properties of the two-fluid model and experimental results might be resolved. R.Eisenschitz

536.48

6569. THE EFFECTIVE DENSITY OF LIQUID HELIUM II. I.M.Lifshits and M.I.Kaganov.
Zh. éksper. teor. Fiz., Vol. 29, No. 2(8), 257-8 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 172-4 (Jan., 1956).

In interpreting experiments with rotating helium it had been assumed that only the normal component rotates whereas the superfluid is at rest. This assumption is revised; it is assumed instead that in a rotating bucket the superfluid breaks up into cylindrical shells and that every shell has a uniform tangential velocity. Expressions are given for the dimensions and velocity of the shells (formulae are not fully explained). By averaging over all shells the effective mass is obtained as a function of the angular velocity. A diagram is added in which this result is shown and which is suited for comparison with experiment. R.Eisenschitz

536.48

6570. ON THE ASYMPTOTIC THEORY OF LIQUID He^3–He^4 MIXTURES. B.K.Agarwal.
Z. Phys., Vol. 145, No. 4, 515-19 (1956).

The paper deals with one of the many models of the state of liquid helium which is supposed to provide the properties of the liquid in terms of atomic properties. A relation between the momentum and energy of a particle in the mixture is introduced by hypothesis. Evaluation of this assumption on lines suggested in the literature results in the thermodynamic properties of the mixtures. The dependence of the λ-point upon the concentration is derived and appears to be in good agreement with measurements. A comparison of theoretical result with an experimental value of the heat effect in mixing the isotopes is not unfavourable. R.Eisenschitz

536.48

6571. THE OSCILLATING SPHERE AT LARGE AMPLITUDES IN LIQUID HELIUM. C.B.Benson and A.C.H.Hallett.
Canad. J. Phys., Vol. 34, No. 7, 668-78 (July, 1956).

Measurements of the damping of the oscillations of a sphere which decay from an initial deflection ~ 10 radians show that two critical amplitudes, denoted by ϕ_c and ϕ_t, may be defined in liquid helium II. The decrement is constant at amplitudes below ϕ_c (a few tenths of a radian), and is caused by the damping due to the viscosity of the normal fluid. ϕ_c is found to be proportional to the square root of the period of oscillation. Above ϕ_c the decrement increases, the superfluid becoming involved in the motion, until it attains another constant value, which is attributed to the viscosity of a single fluid whose density is equal to the total density ($\rho_n + \rho_s$) of liquid helium II. At a larger amplitude ϕ_t (~ 2 radians) the decrement begins to increase linearly with amplitude, and this behaviour, which is also found in liquid helium I and in helium gas at 4° K, is attributed to the onset of turbulence. Reynolds numbers calculated at ϕ_t are ~ 200 for helium II, helium I and helium gas at 4° K. A.

536.5.081

6572. THE INTERNATIONAL TEMPERATURE SCALE AND A REDEFINITION OF THE KELVIN SCALE. J.A.Hall.
Brit. J. appl. Phys., Vol. 7, No. 7, 233-6 (July, 1956).

The Tenth General Conference of Weights and Measures has accepted a re-definition of the Kelvin (absolute) temperature scale in terms of one fixed point, the triple point of water to which a value of 273.16° K has been assigned. The International Temperature Scale continues to be defined in terms of 100° between the ice point (0.0100° C below the triple point of water) and the steam point. The relationship between the scales, and the approved designations are set out in a table. Work is being carried out with a view to future improvement of the international scale. It is hoped that it may be found possible to extend the range covered by the resistance thermometer both above and below its present limits of 630.5° C and – 182.97° C, the latter temperature being the present lower limit of the international scale. If the resistance thermometer scale can be carried up to 1063° C (the freezing point of gold), it will be possible to eliminate the thermocouple as a standard instrument and so improve both the continuity and reproducibility of the scale. A.

536.532 : 621.317.39

6573. THE ACCURACY OF TEMPERATURE MEASUREMENTS WITH THERMOCOUPLES IN PRACTICE. E.Samal.
Elektrotech. Z. (ETZ) B, Vol. 8, No. 5, 197-202 (May 21, 1956). In German.

The couples considered are: Fe-constantan (600°-900° C), NiCr-Ni (900°-1200° C) and PtRh-Pt (1200°-1600° C). (Figures in brackets are max. continuous and short-period operating

emperatures). Permissible tolerances (German), sources of error, compensating leads, effects of cold-junction temperature variations and alteration of circuit resistance are discussed in detail. Methods of increasing accuracy considered are: (1) use of couples with smaller (half) tolerances; (2) indicators with smaller current consumption or with zero consumption (automatic potentiometers); (3) thermostatic control of cold-junction; and (4) zero suppression by constant counter-e.m.f. C.F.Pizzey

536.62

6574. A NEW BUNSEN-TYPE CALORIMETER. R.S.Jessup. J. Res. Nat. Bur. Stand., Vol. 55, No. 6, 317-22 (Dec., 1955).

A calorimeter, using diphenyl ether as the calorimetric substance, is described. Tests of this calorimeter show that it can be used to measure quantities of heat of the order of 38 calories with a precision of about 0.05%. A.

536.63

6575. THERMAL CAPACITY OF A LAYER STRUCTURE FOR LOW TEMPERATURES. E.S.Itskevich and P.G.Strelkov. Dokl. Akad. Nauk SSSR, Vol. 106, No. 5, 805-6 (1956). In Russian.

Measurements of the molecular heat of $CdCl_2$, $CdBr_2$ and CdI_2 in the range 11-60°K have been made; over a range of temperatures above 15-20°K, all show a linear variation with temperature. For lower temperatures the curve appears to be quadratic but interpolation to T = 0°K leads to a negative value of the molecular heat. For CdI_2, the experimental results are in good agreement with those of Dworkin et al. (J. Amer. Chem. Soc., Vol. 77, No. 5, 1304, March 5, 1955) but it is suggested that their law of temperature variation is due to not having sufficient observations at the very low temperatures. J.M.Hough

536.631

6576. THE HEAT CAPACITY OF COPPER BELOW 4.2°K. J.A.Rayne. Austral. J. Phys., Vol. 9, No. 2, 189-97 (June, 1956).

This has been measured with a calorimeter using a mechanical heat switch. The effects of changes in the chemical and physical state of the copper have been investigated with a view to understanding discrepancies between the results of previous workers. It is found that the γ and θ values for copper of spectroscopic purity are in good agreement with those of Corak et al. (1955). Experiments on other specimens, however, reveal a marked dependence of the electronic heat capacity on purity. Possible reasons for this behaviour are discussed, and an evaluation of previous work is given in the light of these results. A.

THERMODYNAMICS 536.7/.8

536.7 : 539.31

6577. THERMOELASTICITY AND IRREVERSIBLE THERMODYNAMICS. M.A.Biot. J. appl. Phys., Vol. 27, No. 3, 240-53 (March, 1956).

A unified treatment is presented of thermoelasticity by application and further developments of the methods of irreversible thermodynamics. The concept of generalized free energy introduced in a previous publication plays the role of a "thermoelastic potential" and is used along with a new definition of the dissipation function in terms of the time derivative of an entropy displacement. The general laws of thermoelasticity are formulated in a variational form along with a minimum entropy production principle. This leads to equations of the Lagrangian type, and the concept of thermal force is introduced by means of a virtual work definition. Heat conduction problems can then be formulated by the methods of matrix algebra and mechanics. This also leads to the very general property that the entropy density obeys a diffusion-type law. General solutions of the equations of thermoelasticity are also given using the Papkovitch–Boussinesq potentials. Examples are presented and it is shown how the generalized coordinate method may be used to calculate the thermoelastic internal damping of elastic bodies. A.

536.7 : 539.132

6578. CALCULATION OF THERMODYNAMIC FUNCTIONS FOR POLYATOMIC MOLECULES. H.W.Woolley. J. Res. Nat. Bur. Stand., Vol. 56, No. 2, 105-10 (Feb., 1956).

Formulae are given from which the thermodynamic functions may be obtained for polyatomic molecules not exhibiting special phenomena, such as internal rotation. The effects of first and second order anharmonicities and rotational-vibrational interaction are treated in detail, as also are the angular momentum effects of doubly degenerate vibrations in linear molecules. This paper presents formulae for the corrections carried to higher order than has hitherto been available. A.

536.7

6579. THERMODYNAMICS AND STATISTICAL MECHANICS AT NEGATIVE ABSOLUTE TEMPERATURES. N.F.Ramsey. Phys. Rev., Vol. 103, No. 1, 20-8 (July 1, 1956).

The circumstances under which negative absolute temperatures can occur are discussed, and principles of thermodynamics and statistical mechanics at negative temperatures are developed. If the entropy of a thermodynamic system is not a monotonically increasing function of its internal energy, it possesses a negative temperature whenever $(\partial S/\partial U)x$ is negative. Negative temperatures are hotter than positive temperatures. When account is taken of the possibility of negative temperatures, various modifications of conventional thermodynamics statements are required. For example, heat can be extracted from a negative-temperature reservoir with no other effect than the performance of an equivalent amount of work. One of the standard formulations of the 2nd law of thermodynamics must be altered to the following: It is impossible to construct an engine that will operate in a closed cycle and provide no effect other than (1) the extraction of heat from a positive-temperature reservoir with the performance of an equivalent amount of work or (2) the rejection of heat into a negative-temperature reservoir with the corresponding work being done on the engine. A thermodynamic system that is in internal thermodynamic equilibrium, that is otherwise essentially isolated, and that has an energetic upper limit to its allowed states can possess a negative temperature. The statistical mechanics of such a system are discussed and the results are applied to nuclear spin systems. A.

536.7 : 538.12

6580. ON SOME THERMODYNAMICAL INEQUALITIES. V.P.Silin. Zh. éksper. teor. Fiz., Vol. 30, No. 1, 197-9 (1956). In Russian.

Relationships between magnetic flux density (B) and field strength (H) are derived in terms of various thermodynamical functions. J.M.Hough

536.7 : 519.2

GENERALIZATION OF THE EHRENFEST URN MODEL. See Abstr. 5599

536.75

6581. ENTROPY AND THE EHRENFEST URN MODEL. M.J.Klein. Physica, Vol. 22, No. 7, 569-75 (July, 1956).

Both Boltzmann and Gibbs entropies are discussed. It is shown that they agree at equilibrium. The Boltzmann entropy shows fluctuations in time while the Gibbs entropy is proved to increase monotonically to its maximum (equilibrium) value. The concepts of equilibrium associated with the two points of view are compared. A.

536.755

6582. A FUNDAMENTAL EQUATION IN THE THEORY OF IRREVERSIBLE THERMODYNAMIC PROCESSES. K.A.Popov. Dokl. Akad. Nauk SSSR, Vol. 106, No. 3, 422-4 (1956). In Russian.

A discussion and proof of Denbigh's equation for the rate of increase of entropy in various natural processes in systems whose state is completely determined by a singe variable; the various forms of the equation are deduced for adiabatic processes, for isothermal isobaric processes, and for isothermal processes involving heat exchange with the surrounding medium, but no performance of external work. R.C.Murray

ELECTRICITY 537

537.123

6583. ON THE PION ANNIHILATION OF NUCLEON-ANTIPROTON PAIRS. D.Amati and B.Vitale.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1411-24 (June, 1956).

The pion annihilation of antiproton-nucleon pairs in bound S-states (singlet and triplet) are analysed taking into account conservation law and selection rules previously founded. With a statistical model for the valuation of transition matrix elements the ratio of three pion to two pion annihilation is calculated and, for the 3π annihilation, the angular distributions and energy spectrum of the final mesons. Finally some considerations are given about the annihilation of the pair from isotopic spin eigenstates. A.

537.123

6584. ANTI-PROTON ANNIHILATION. H.A.Bethe and J.Hamilton.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 1-22 (July, 1956).

It is shown how simple experiments on the annihilation of the antiproton in various materials may be used to determine the nature of the annihilation process in nuclear matter, and to get information on nucleon—antinucleon forces. The annihilation of antiprotons from atomic states is examined in detail, and corrections are made for specifically nuclear effects. A.

ELECTROSTATICS. DIELECTRICS 537.2

537.213

6585. THE POTENTIAL OF DOUBLY CURVED CONDENSERS. R.Albrecht.
Z. Naturforsch., Vol. 11a, No. 2, 156-63 (1956). In German.

For a class of toroidal condensers the potential is investigated by means of series developments. The converse problem of determining the parameters of toroidal condensers by means of which a given field distribution may be realized is also treated. H.Motz

537.22 : 541.18.047.5

6586. THE DETERMINATION OF THE VOLTAGE—CURRENT RELATIONSHIPS IN THE SIMPLE IONIZING SYSTEMS. APPLICATION TO THE PLATE ELECTRO-FILTER. J.Dupuy.
C. R. Acad. Sci. (Paris), Vol. 242, No. 19, 2309-12 (May 7, 1956). In French.

In order to apply the formulae for the ionizing field obtained previously (Abstr. 5181/1956), an expression is obtained relating the current and the voltage in a plate type precipitator. The paths of particles predicted from the theory are stated to be in order-of-magnitude agreement with the experimental results. J.Dutton

537.222 : 537.525

6587. THE POTENTIAL OF A CHARGE BETWEEN PARALLEL PLATES AND THE "WALL EFFECT" OF ELECTRON AVALANCHES. L.Frommhold.
Z. Phys., Vol. 145, No. 3, 324-40 (1956). In German.

The electrostatics of a moving charge in initially uniform field conditions are given analytically and the results are related to various experimental cases. For example, avalanches in methylal (pd = 16.4 cm x mm Hg) are discussed and comparison is made between calculated and oscillographically observed avalanche pulses. An effect, previously interpreted in terms of attachment processes, is shown to be due to avalanches produced near the field edges. J.D.Craggs

537.224

6588. A NEW THEOREM IN ELECTROSTATICS AND ITS APPLICATION TO CALCULABLE STANDARDS OF CAPACITANCE. A.M.Thompson and D.G.Lampard.
Nature (London), Vol. 177, 888 (May 12, 1956).

A class of capacitor in which capacitance depends only upon one length to the first order is noted. In the class the capacitance per unit length between opposing components of a cylindrical conducting shell which is divided into four parts by two planes at right angles, one plane containing an axis of symmetry, is shown to be = $(\ln 2/4\pi^2)$ e.s.u. This fact is used in the construction of standard condensers as low as 1pF accurate to 1 part in 10^5. C.G Morgan

537.226

6589. DIELECTRIC PROPERTIES OF A LATTICE OF ANISOTROPIC PARTICLES. Z.A.Kaprielian.
J. appl. Phys., Vol. 27, No. 1, 24-32 (Jan., 1956).

The constitutive dielectric parameters for uniform space arrays of generalized structural geometry composed of similarly oriented elements of completely generalized material and shape are derived. The theoretical procedure employed in evaluating these parameters is analogous to the classical method applied to the study of the dielectric properties of non polar media and assumes that the disturbing action of each particle on a uniform static field can be allowed for, if each particle is replaced by a set of dipoles. Consequently, the results are applicable to microwave frequencies only if the cross-sectional dimensions and interelemental spacings remain small compared to the wavelength. The general result is particularized for the case in which the elements are spherical objects with a tensor permeability and scalar dielectric constant. The results have several applications to the design of artificial dielectrics and some of these are given. A.

537.226.1

6590. EFFECTIVE DIELECTRIC CONSTANT OF HETEROGENEOUS MEDIA. R.S.Smith.
J. appl. Phys., Vol. 27, No. 7, 824-31 (July, 1956).

A method for measuring the dielectric constant and conductivity of powders is described. Numerous formulae of earlier workers pertaining to the dielectric constant of porous media of low density are discussed. It is then shown that these relations incorrectly predict a value of the intrinsic dielectric constant which is a function of density. In an effort to develop a formula which would predict correctly the density dependence to at least a medium range of densities, a calculation is presented which expresses the effective dielectric constant of a given system as a function of particle shape, intrinsic dielectric constant, powdered density, and packing properties of powders composed of ellipsoidal particles. The formula involves the demagnetization coefficient and intrinsic dielectric constant of the powder particles. Data obtained from measurements of dielectric constant of magnesium oxide, silica, polystyrene, zinc oxide, etc., were applied to this formula and the intrinsic dielectric constants inferred agreed with bulk measurements by other workers and the particle shapes derived from dielectric measurements agreed with other physical properties of the powder. A.

537.226.1.08

6591. A SIMPLE, SMALL DIELECTRIC TEST CELL FOR LIQUIDS. S.Baxter and P.D.Wilmot.
J. sci. Instrum., Vol. 33, No. 8, 315-16 (Aug., 1956).

An easily constructed guard ring test cell, which is both robust and precise, is described. Its calculated capacitance has been compared with values estimated from results using liquids of known dielectric constant and good agreement obtained. A.

537.226.2

6592. RECTILINEAR BIREFRINGENCE AND DICHROISM OF PAPER AT 9350 Mc/s. R.Servant and J.Gougeon.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2318-20 (May 7, 1956). In French.

The standing wave pattern was measured in a length of slotted rectangular waveguide packed with sheets of kraft paper 0.11 mm thick and of 0.91 g/dm^2. The sheets lay along the length of the guide and were either parallel or perpendicular to the electric field in the guide. The real part of the permittivity was found to be 2.30 parallel and 1.64 perpendicular, and the loss tangent to be 0.10 parallel and 0.05 perpendicular to the field. F.F.Roberts

537.226.2

6593. DIELECTRIC PROPERTIES OF NITROBENZENE IN THE REGION OF ANOMALOUS DISPERSION. G.L.Clark.
J. chem. Phys., Vol. 25, No. 1, 125-9 (July, 1956).

The complex dielectric constant of highly purified nitrobenzene in the region of anomalous dispersion has been determined by measuring the input impedance of a variable length of a coaxial transmission line filled with the liquid. The measurements were carried out at frequencies from 0.65 kMc/s to 3.00 kMc/s in the temperature range between 15° C and 50° C. Good agreement was observed with an expression suggested by Cole and Cole, and the critical frequencies in this temperature region were found to be between 3 and 6 kMc/s. A.

537.226.2

6594. DIELECTRIC CONSTANT OF WATER FROM 0° TO 100° C. C.G.Malmberg and A.A.Maryott.
J. Res. Nat. Bur. Stand., Vol. 56, No. 1, 1-8 (Jan., 1956).

An equal ratio arm, capacitance-conductance bridge, operated at frequencies below 100 kc/s, was used to measure the dielectric constant with an accuracy of better than 0.1% at 5 deg. intervals. At 25° C the dielectric constant was found to have the value 78.30, which is about 0.3% lower than that usually accepted. The data fit the equation

$$\epsilon = 87.740 - 0.40008t + 9.398(10^{-4})t^2 - 1.410(10^{-6})t^3,$$

with a maximum deviation of 0.01 unit in dielectric constant. The experimental method and sources of error are considered in some detail. A.

537.226.2 : 538.213 : 621.318.1 : 621.315.611

6595. DIELECTRIC CONSTANT AND PERMEABILITY OF ARTIFICIAL DIELECTRICS AT 3 cm WAVELENGTH.
E.Meyer, H.J.Schmitt and H.Severin.
Z.angew. Phys., Vol. 8, No. 6, 257-63 (1956). In German.

The theoretical permittivity and dielectric loss tangent as functions of the particle conductivity, and the theoretical permeability and magnetic loss tangent as functions of the particle radius, are derived from Lewin's expressions (Abstr. 1211/1947) and shown graphically for conducting non-magnetic particles in a loss-free non-magnetic dielectric medium. Experimental measurements are described and results shown, as functions of volume packing ratio, for particles of Cu, Zn, Fe, Bi, Cu sulphide, Si, carbon microphone granules, and graphite, each in paraffin wax. Further results are tabulated for Cr_2O_3, Fe_2O_3, Se and two ferroxcubes. The magnetic results agree well with theory, but the measured dielectric constants are higher and the losses appear at much higher conductivities than expected. F.F.Roberts

537.226.2

6596. DEPENDENCE OF THE DIELECTRIC PROPERTIES OF CERAMIC $BaTiO_3$ FOR HIGH FREQUENCY CURRENTS ON THE TECHNOLOGY OF THE PREPARATION OF SAMPLES. M.Jeżewski and T.Piech.
Acta phys. Polon., Vol. 14, No. 5, 395-405 (1955).

The dependence of the dielectric constant and the ceramic $BaTiO_3$ losses on the way of preparing samples has been investigated. The method of measurements of the dielectric constate of materials having very high dielectric constants has been worked out with the help of high frequency currents, as well as the method of measurements of losses. Four groups of $BaTiO_3$ samples, marked A, B, C, D, have been prepared, each of them being obtained from the previous one by means of thorough grinding, pressing, and resintering at a temperature of about 1350° C. The last group, D, remained particularly long in the over: about 130 hours, including the time of heating and cooling. It has been proved that the dielectric constant of each successive group of samples is at all temperatures considerably higher than the dielectric constant of the previous group. The losses of samples in the row A, B, C, D decrease gradually but not very significantly. A.

537.226.2 : 537.228.1

6597. THE DIELECTRIC AND PIEZO-ELECTRIC PROPERTIES OF THE SOLID SOLUTIONS (Ba, Sr)TiO_3, (Ba, Pb)TiO_3, Ba(Ti, Sn)O_3 AND Ba(Ti, Zr)O_3. N.A.Roĭ.
Akust. Zh., Vol. 2, No. 1, 62-70 (1956). In Russian.

The temperature variation of the permittivity of solid solutions based on barium titanate has been determined experimentally, the piezo-electric moduli measured and the magnitude of the coercive force found at room temperature. The solid solutions of the titanates of barium and lead, barium titanate and barium stannate were studied for transducer applications. C.R.S.Manders

537.226.31 : 539.133

6598. ON THE ABSORPTION OF 3.18 CM MICROWAVES IN SOME SUBSTITUTED PHENOLS IN THE LIQUID STATE. D.K.Ghosh.
Indian J. Phys., Vol. 29, No. 12, 581-6 (Dec., 1955).

The absorption of 3.18 cm microwaves in o-bromophenol, 2,4,6-trichlorophenol, o-methoxy phenol, p-cresol and diphenyl ether have been studied for different temperatures of the liquids in continuation of previous investigations. Maximum absorption of 3.18 cm microwaves has been exhibited by o-methoxy phenol at 100° C and p-cresol at 90° C and the values of the radii of the rotors calculated from Debye's theory indicate that these absorption maxima are due to rotation of the substituent OH group about the C-O bond. o-Bromophenol, 2,4,6-trichlorophenol and diphenyl ether did not show any absorption in the 3.18 cm microwave region when the temperatures of the liquids were changed from the freezing points to the boiling points. It is pointed out that these three molecules do not show absorption in this region owing to restriction of the rotational freedom of the OH group in the first two cases and absence of such small group as substituent in the case of diphenyl ether. A.

537.226.31

6599. DIELECTRIC HEATING OF QUARTZ OSCILLATING IN SEVERAL ORGANIC LIQUIDS. S.Parthasarathy and V.Narasimhan.
Z. Phys., Vol. 145, No. 4, 508-10 (1956). In German.

The dielectric heating has been measured by the substitution method and its dependence on the nature of the liquid in which the crystal oscillates has been examined. A.

537.226.33

6600. POLARIZATION REVERSAL IN THE BARIUM TITANATE HYSTERESIS LOOP. R.Landauer, D.R.Young and M.E.Drougard.
J. appl. Phys., Vol. 27, No. 7, 752-8 (July, 1956).

In the presence of an opposing field the polarization of

tetragonal $BaTiO_3$ reverses itself. Devonshire's phenomenological treatment shows that in a sufficiently large opposing field the original direction of polarization becomes unstable. The values of commonly observed coercive fields are much smaller than this, and the polarization actually reverses while the initial state is still metastable. The observed coercive field and the shape of the audio-frequency hysteresis loop can, however, be explained in terms of the field dependence of the switching rate that was measured by Merz in pulse experiments. Measurements by Drougard, Funk and Young, of the small signal conductivity, taken while traversing the hysteresis loop, are also explained in term of Merz's rate. The absence of an appreciable inductive component in the small signal conductivity measurements indicates that variations in the applied field produce corresponding variations in the switching current with a time lag which is at most a few times 10^{-8} second and possibly much less. The increases in dielectric constant measured during switching remain unexplained. A.

537.226.33 : 548.7

6601. DIELECTRIC RELAXATION FOR A THREE-DIMENSIONAL ROTATOR IN A CRYSTALLINE FIELD: THEORY FOR A GENERAL SIX-SITE MODEL. B.M.Axilrod.
J. Res. Nat. Bur. Stand., Vol. 56, No. 2, 81-6 (Feb., 1956).

A theory of dielectric relaxation is presented for a generalized six-site model where the transition probabilities for the turning of dipoles from one orientational site to another are arbitrary. The sites are arranged in three dimensions. The nature of the set of discrete relaxation times generated by this model is examined in a general manner. It is found that the relaxation times are all real and positive and the range of the relaxation times is established. A.

537.226.8 : 621.315.615

6602. PRE-BREAKDOWN PROCESSES IN LIQUIDS. I.E.Balygin.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 464-70 (1956). In Russian.

Results of the investigation of pre-breakdown processes in transformer and castor oil and also in xylene and distilled water are presented. It is shown that at breakdown voltages the ionization by collision during the statistical delay time is accompanied by electron showers and small streamers which require about 10^{-8} sec. The streamers do not always lead to the progressive breakdown but are a preparatory step. It has been established that this step can take place in xylene and castor oil when the streamer current is not less than 5 to 8×10^{-5} A. It is also shown that in distilled water the breakdown mechanism for strongly inhomogeneous electric fields depends on the polarity of the point. If the polarity of the latter is positive during the statistical delay time a positively charged column of small radius is formed in 5×10^{-6} sec. A.

537.226.8 : 621.317.333.6

6603. ROTATING ELECTRODE UNIT FOR MEASUREMENTS OF THE ELECTRIC STRENGTH OF INSULATING LIQUIDS. A.Powell and K.H.Stark.
J. sci. Instrum., Vol. 33, No. 4, 163 (April, 1956).

It is desirable to use fresh electrode surfaces for successive breakdown tests. The unit was devised to permit this for 0.01 inch gaps with $< 10\%$ variation in electrode separation on rotation and $< 3\%$ variation during a test. I.D.L.Ball (R)

537.227

6604. DYNAMIC METHOD FOR MEASURING THE PYROELECTRIC EFFECT WITH SPECIAL REFERENCE TO BARIUM TITANATE. A.G.Chynoweth.
J. appl. Phys., Vol. 27, No. 1, 78-84 (Jan., 1956).

A dynamic method has been developed for the study of the pyroelectric effect. Transient currents produced in single crystals of barium titanate when subjected to flashes of light are shown to be pyroelectric in origin. The illumination results in a small change in the temperature of the crystal which in turn, causes the polarization to change. This change is recorded as a current in the external circuit. It is shown that from room temperature up to the Curie point, the pyroelectric current is consistent with the polarization as a function of temperature, as determined from hysteresis loop measurements. The technique proves to be a sensitive and nondestructive method for studying the state of polarization of a crystal. The technique is used to study the pyroelectric effect induced by applied static electric fields at temperatures above the Curie point. The results are consistent with Devonshire's theory of the ferroelectricity of $BaTiO_3$ and they confirm that the Curie-point transition is of the first order. A.

537.227

6605. RETARDED POLARIZATION PHENOMENA IN $BaTiO_3$ CRYSTALS. H.H.Wieder.
J. appl. Phys., Vol. 27, No. 4, 413-17 (April, 1956).

Slow polarization phenomena in $BaTiO_3$ c-domain crystals were observed for applied electric fields smaller than 1 kV/cm. It is shown that the rate of change of polarization with time for small but constant fields implies the same phenomena observed for switching experiments performed at fields considerably larger than 1 kV/cm. No threshold field was found below which antiparallel nuclei would not propagate and complete the polarization reversal cycle. A.

537.228.1

6606. SYNTHETIC QUARTZ FOR PIEZOELECTRIC PURPOSES. H.Awender and K.Sann.
Elektron. Rdsch., Vol. 10, No. 3, 76-7 (March, 1956). In German.

Some properties are given of synthetic quartz produced by Brush Laboratories (U.S.A.). V.G.Welsby

537.228.1

6607. PROPERTIES OF PIEZOELECTRIC CERAMICS IN THE SOLID-SOLUTION SERIES LEAD TITANATE–LEAD ZIRCONATE–LEAD OXIDE: TIN OXIDE AND LEAD TITANATE–LEAD HAFNATE. B.Jaffe, R.S.Roth and S.Marzullo.
J. Res. Nat. Bur. Stand., Vol. 55, No. 5, 239-54 (Nov., 1955).

Compositional proximity to a morphotropic transformation between two ferroelectric solid-solution phases seems to yield ceramic transducers having desirable properties over a wide range of temperature. Examples of this phenomenon were observed in the systems $PbTiO_3$–$PbZrO_3$, $PbTiO_3$–$PbO : SnO_2$, $PbTiO_3$–$PbZrO_3$–$PbO : SnO_2$, and $PbTiO_3$–$PbHfO_3$. The dielectric and piezoelectric properties of ceramics having compositions in these systems and in the system $PbZrO_3$–$PbO : SnO_2$ are described. The composition $Pb(Ti_{.48}Zr_{.55})O_3$ exhibits a high radial coupling coefficient, greater than 0.3, for temperatures as high as 275°C and has the highest g_{31} constant, 11.7×10^{-3} volt-metres per newton. For the series of compositions containing 30% $PbO : SnO_2$ in the ternary system $PbTiO_3$–$PbZrO_3$–$PbO : SnO_2$ the tetragonal composition nearest the morphotropic boundary has the highest d_{31} value, 74×10^{-12} coulombs per newton. The rhombohedral composition nearest the morphotropic boundary shows the least change of frequency constant with temperature, a 2% variation over the range of 25° to 225°C. A.

537.228.2

6608. DETERMINATION OF THE ELECTROSTRICTION CONSTANT Q_{11} OF BARIUM TITANATE CERAMIC. G.Schmidt.
Z. Phys., Vol. 145, No. 4, 534-42 (1956). In German.

The electrostriction constant Q_{11} of a block of $BaTiO_3$ ceramic was found to be 0.6×10^{-12} c.g.s.u. at 20°C. Measurements were continued up to 150°C showing a dip to half this value at 110°C and a constant value of about 0.7×10^{-12} above 120°C. Measurements were made at about 50 kc/s, the displacement of the specimen being measured with a capacity probe, itself calibrated by the electrostriction of a quartz block. A.L.Mackay

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.1 : 539.234

6609. ELECTRICAL CONDUCTIVITY OF ANISOTROPIC THIN FILMS. E.H.Sondheimer.
. Phys. Radium, Vol. 17, No. 3, 201-3 (March, 1956).
"International colloquium on thin films". See Abstr. 6956).
n French.

In thin metallic films the effective free path of the conduction electrons is shortened by collisions with the surfaces of the film and, when the thickness is small compared with bulk free path, the current is carried mainly by electrons which move nearly parallel to the surface. As a consequence, when the orientation of the crystal axes relative to the surface is varied in single crystal films, different groups of electrons corresponding to different regions of the Fermi surface become prominent in determining the resistance, and the resistance may therefore by expected to show a much greater variety of anisotropic behaviour than is observed in the bulk metal. It is suggested that measurements of the anisotropy of the resistance of single crystal films may provide useful information about the shape of the Fermi surface in metals. A.

537.311.1 : 539.234

6610. THE MEAN FREE RANGE OF CONDUCTION ELECTRONS AND PHOTOELECTRONS. MEASUREMENT BY MEANS OF THE THIN-LAYER METHOD. H.Mayer, R.Nossek and H.Thomas.
J. Phys. Radium, Vol. 17, No. 3, 204-9 (March, 1956).
("International colloquium on thin films". See Abstr. 6956).
In French.

First results of a measurement on potassium are given. A.

537.311.1 : 539.234

6611. NATURE OF ELECTRICAL CONDUCTION IN VERY THIN METALLIC FILMS. G.Darmois.
J. Phys. Radium, Vol. 17, No. 3, 211-12 (March, 1956).
("International colloquium on thin films". See Abstr. 6956).
In French.

The film is assumed to be formed from separated grains. Between these grains, a two-dimensional electron gas is assumed. The application of the theory of Drude–Lorentz to this gas gives the resistance of the film. A.

537.311.1 : 539.234

6612. CONTRIBUTION TO THE STUDY OF THE ELECTRICAL CONDUCTIVITY OF THIN METALLIC LAYERS AT LOW TEMPERATURES. B.Vodar.
J. Phys. Radium, Vol. 17, No. 3, 213-19 (March, 1956).
("International colloquium on thin films". See Abstr. 6956).
In French.

Contains the following main experiments: (1) experimental methods for obtaining stable and clean metallic layers on glass, a few atoms thick. (2) Measurements of the d.c. resistance of these layers down to 4.2°K. The results concern: (1) the variation with the temperature, implying a small activation energy; (2) effect of adsorbed gases, which decrease the resistance; (3) effect of applied potential expressed by a linear relation between log R(F) et $F^{1/2}$, F being the average field; (4) effect of a dielectric layer on the field effect; (5) field effect for low fields and for strong fields (saturation). The origin of the observed phenomena are briefly discussed. The activation energy may be due to the potential wall between particles or atoms; the field effect is then a modified form of the Shottky effect; the adsorbed gases may reduce the height of the wall. The small value of the activation energy is possibly due to the fact that the electrons never escape far enough from the particles. Another origin for the activation energy is connected with the surface states and the possible gap between Brillouin zones in a 2 dimensional array. A.

537.311.1 : 539.234

6613. EFFECT OF BRILLOUIN'S STRATIFIED ZONE ON THE ELECTRIC PROPERTIES OF THIN FILMS.
E.C.Crittenden, Jr and R.W.Hoffman.
J. Phys. Radium, Vol. 17, No. 3, 220-3 (March, 1956).
("International colloquium on thin films". See Abstr. 6956).
In French.

The electrical resistivity, ρ, and temperature coefficient of resistivity α, have been measured on films of nickel down to 22 A thick. At small thicknesses the curves behave as if the mean free path of the material of the film is increased. It seems likely that this is the result of restrictions imposed by boundary conditions on the component of momentum of the electrons perpendicular to the plane of the films. The Brillouin zones and the Fermi surface will be crossed by planes on which the allowed electron states lies. This alters the small angle scattering by phonons to favour scattering involving no change in the component of momentum perpendicular to the film. This increases the effective mean free path, as regards collisions with the surface. The shapes of the curves are well fitted by employing an effective mean free path proportional to the reciprocal of the thickness, at small thickness. A.

537.311.1 : 539.234

6614. SCINTILLATION EFFECT AND STRUCTURE OF THIN METALLIC LAYERS. J.P.Borel.
J. Phys. Radium, Vol. 17, No. 3, 224-9 (March, 1956).
("International colloquium on thin films". See Abstr. 6956).
In French.

Study of the scintillation effect of thin layers of Ag and In for frequencies between 16 c/s and 100 kc/s. For small currents, a law is found in the form of: $e = k(I^2/\nu)$. For very thin layers, which are not continuous, this law does not hold if I_c is greater than a certain limit. The discrepancy is particularly noticeable at low frequencies. Scintillation effect of layers of various thicknesses is studied in relation to their structure (observed by electronic microscope). A.

537.311.1 : 539.234

6615. CONDUCTION MECHANISM IN GRANULAR THIN FILMS AND RELATION TO THE SCINTILLATION EFFECT.
A.Blanc-Lapierre and N.Nifontoff.
J. Phys. Radium, Vol. 17, No. 3, 230-6 (March, 1956).
("International colloquium on thin films". See Abstr. 6956).
In French.

After general considerations concerning the orders of magnitude, some theoretical and experimental results on the electric conductivity and the flicker effect of thin granular metallic films are resumed. An important relation between the two phenomena is indicated and a theoretical interpretation is proposed. A.

537.311.1 : 539.234

6616. STUDY OF THE ELECTRICAL CONDUCTION OF THIN METALLIC FILMS AT HIGH FREQUENCIES. S.Offret and B.Vodar.
J. Phys. Radium, Vol. 17, No. 3, 237-40 (March, 1956).
("International colloquium on thin films". See Abstr. 6956).
In French.

The electrical resistance of thin films evaporated on glass decreases with increasing frequencies; the variation is more important at very low temperatures. This effect is accounted for by the existence of capacities between aggregates. This measures at high frequencies can give informations about metallic conduction within grains, while measurements with direct current inform about the work function of electrons. A.

537.311.1 : 530.162

6617. ON A THEORY OF THE ELECTRICAL CONDUCTIVITY OF METALS. P.S.Zyryanov.
Zh. éksper. teor. Fiz., Vol. 29, No. 2 (8), 193-200 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 247-51 (March, 1956).

The fluctuations of potential of the internal electric field in the electron-ion plasma of a metal and the electrical resistivity dependent on the scattering of electrons by these fluctuations are calculated. A.

537.311.1 : 530.162

6618. RELAXATION FLUCTUATIONS IN CONDENSED SYSTEMS. P.S.Zyryanov.
Zh. éksper. teor. Fiz., Vol. 29, No. 3 (9), 334-8 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 236-9 (March, 1956).

The question of the division of fluctuations into "fine-grained" (relaxational) and "coarse-grained" (vibrational) is considered. An estimate of the role of relaxation fluctuations in the electrical conductivity of metals is given. A.

537.311.3.083 : 621.317.734

6619. A WIRE WOUND POTENTIOMETER USED AS A SIMPLE AID IN THE PRECISION MEASUREMENT OF VERY HIGH RESISTANCES BY THE TOWNSEND METHOD. H.Mette.
Z. angew. Phys., Vol. 8, No. 4, 191-3 (1956). In German.

Describes the construction and operation of a double potentiometer. On section provides linearly variable voltage in the Townsend circuit; the second switches an electric chronometer on and off, in synchronism with the voltage control. Resistances of 10^{10} to 10^{14} ohm are measured to an accuracy of 0.1%. J.H.Mason

537.311.31

6620. EFFECT OF QUENCHING ON THE RESISTIVITY OF Au–Cd. M.S.Wechsler and T.A.Read.
J. appl. Phys., Vol. 27, No. 2, 194-5 (Feb., 1956).

Single crystals of nominal composition 47.5 and 49 atomic % Cd were used. Quenching from temperatures in the range 400-500° C to slightly elevated temperatures 40-70° C, was found to lead to marked changes in subsequent transformation behaviour. C.A.Hogarth

537.311.31 : 537.583

6621. CONDUCTION MECHANISM IN OXIDE-COATED CATHODES. E.B.Hensley.
J. appl. Phys., Vol. 27, No. 3, 286-90 (March, 1956).

Measurements have been made on a system composed of two parallel planar cathodes so arranged that their surfaces may be pressed together or separated by a small gap. Low-field conductivity measurements show that above approximately 700° K, the conductance of the system does not depend on physical contact between the cathode surfaces. This result supports the theory that the high-temperature conductivity is a property of the electron gas in the cathode pores. The ratio of conductivity to thermionic emission was measured under conditions designed to preserve the state of activation of the cathode surface. The results agreed with the theoretically predicted ratio and demonstrate that the higher values previously reported were caused by a lewer activation on the surface than in the interior of the cathode. A.

537.311.31

6622. SOME RESISTIVITY EFFECTS OF SHORT-RANGE ORDER IN α BRASS. A.C.Damask.
J. appl. Phys., Vol. 27, No. 6, 610-16 (June, 1956).

The annealing kinetics of resistance changes produced in 30% Zn α-brass by quench, neutron irradiation at 50° C, and cold work have been studied. It is shown that the relaxation times for these changes agree with those obtained from measurements of stress-induced changes in local order. These resistance changes are therefore interpreted in terms of changes in short-range order. Measurements of resistance as a function of temperature show that an increase of short-range order decreases ρ_0, the residual resistance, and increases ρ_T, the thermal part of resistance. A.

537.311.32

6623. ELECTRON BOMBARDMENT CONDUCTIVITY IN SILVER BROMIDE SINGLE CRYSTAL. II. C.Yamanaka, H.Sakai and T.Suita.
J. Phys. Soc. Japan, Vol. 11, No. 5, 605 (May, 1956).

For Pt I, see Abstr. 4641 (1955). A 10 kV electron beam was used to induce conductivity and the electron mobility observed as a function of temperature from 90 to 300° K. The results show that the electron mobility does not increase so markedly at low temperatures as theory predicts. Further work is in progress on crystals which are more pure and less strained. W.Bardsley

537.311.32

6624. C-AXIS ELECTRICAL CONDUCTIVITY OF GRAPHITE. W.Primak.
Phys. Rev., Vol. 103, No. 3, 544-6 (Aug. 1, 1956).

Small crystals of natural graphite showing no evidence of twinning were found in a sample of marble from the Lead Hill mine (Ticonderoga, New York). They were isolated, handled very carefully to avoid deformation, and their c-axis conductivity determined. It was found to be about $2 \times 10^2 (\text{ohm cm})^{-1}$, in accord with previous measurements of less perfect crystals. It is shown that much of the variability in the measurements of larger, less perfect crystals is caused by nonuniform current flow. However, evidence is adduced to indicate that the actual c-axis conductivity of natural graphite crystals does vary somewhat. A.

537.311.32.08

6625. NEW LOW CONTACT RESISTANCE ELECTRODE. S.S.Flaschen and L.G.Van Uitert.
J. appl. Phys., Vol. 27, No. 2, 190 (Feb., 1956).

Apparent resistivities of high density homogeneous nickel ferrite ceramic specimens were measured as a function of voltage (0.01 V to 140 V), using various electrodes including those evaporated, fired, painted and rubbed on. Rubbed on indium amalgam gave constant resistivity over the entire voltage range. This was also the lowest measured value, being identical with the true resistivity of the specimen as measured by other means. An indium-gallium alloy had similar properties. M.R.Hopkins

537.311.33

6626. ON THE THEORY OF HOLES. I. OPTICAL TRANSITIONS. G.Helmis.
Ann. Phys. (Leipzig), Vol. 17, No. 6-8, 356-70 (1956). In German.

A new method of analysis based on one due to M.Lax (1952) is utilized and the form of the optical absorption curve corresponding to hole transitions is obtained. C.A.Hogarth

537.311.33

6627. THERMAL CONDUCTIVITY OF SEMICONDUCTORS. J.M.Thuillier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 22, 2633-4 (May 28, 1956). In French.

An error in sign in a previous paper (Abstr. 2083/1956) relating to the transport of kinetic energy by the hole electron pairs is acknowledged. W.Bardsley

537.311.33 : 536.21

6628. THE THERMAL CONDUCTIVITY OF SEMICONDUCTORS. A.V.Ioffe and A.F.Ioffe.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, No. 1, 65-75 (1956). In Russian.

Two mechanisms of thermal conductivity exist in semiconductors, viz. one of heatwave character (phonons) and an electronic mechanism; the latter is directly related to the electrical conductivity and differs according to whether the lattice electrons are in the non-degenerate or degenerate state. The electronic mechanism is strongly influenced by the flow of, and the consequent capture of phonons by electron-

ole pairs and excitons, and by the radiant energy transfer.
Electrical Research Association

537.311.33 : 548.5

629. FORMATION OF P-N JUNCTIONS IN SEMICONDUCTORS BY THE VARIATION OF CRYSTAL GROWTH PARAMETERS. H.E.Bridgers.
J. appl. Phys., Vol. 27, No. 7, 746-51 (July, 1956).

The fluid transport theory of Burton et al. for the variation of the effective distribution coefficient with growth rate and stirring is applied to the growth of semiconductor crystals from a melt containing both donor and acceptor impurities. "Rate growing", or the formation of p-n junctions by varying the growth rate, is considered and the importance of the ratio of melt concentrations is demonstrated. Junction formation by varying the degree of stirring in the melt, or "stirring modulation" is also described. General principles are derived and various applications are discussed. A.

537.311.33

6630. NATURE OF AN OHMIC METAL–SEMICONDUCTOR CONTACT. F.A.Kröger, G. Diemer and H.A.Klasens.
Phys. Rev., Vol. 103, No. 2, 279 (July 15, 1956).

A brief discussion is given of various existing models for an ohmic contact between semiconductor like CdS and a metal. An alternative model is proposed according to which the ohmic nature is brought about by a thin layer of highly conducting n-type CdS underneath the electrode. A.

537.311.33 : 537.311.4

6631. SURFACE BARRIERS AT SEMICONDUCTOR CONTACTS. R.Stratton.
Proc. Phys. Soc. B, Vol. 69, Pt 5, 513-27 (May, 1956).

The voltage–current and capacity–current characteristics for current flow across a surface of discontinuity between two semiconductors have been derived. Both the diode and diffusion theories are dealt with, the former being treated in detail for Mott barriers and the latter for Schottky barriers. The results are applied to measurements on silicon carbide point contacts and a grain boundary in germanium respectively. The resistance is shown to be consistent with a barrier which is caused by donor and acceptor surface states. On SiC the density of these states is about 10^{13} cm^{-2} and on Ge about 3×10^{11} cm^{-2}. A.

537.311.33 : 537.311.62

6632. HIGH FREQUENCY CONDUCTIVITY IN SEMICONDUCTORS. B.Donovan and N.H.March.
Proc. Phys. Soc. B, Vol. 69, Pt 5, 528-38 (May, 1956).

The theory of the electrical conductivity in alternating fields is developed for non-degenerate semiconductors with spherical energy surfaces. As in the Drude–Zener theory, the conductivity is a complex quantity and the real and imaginary parts are derived as functions of frequency and of temperature. The cases of lattice scattering and impurity scattering are investigated separately for single-band models and the results are applied to intrinsic semiconductors by considering the two-band model with lattice scattering, and to impurity semiconductors by combining the scattering mechanisms. The loss tangent is also calculated and a comparison is made with the available experimental data. A.

537.311.33

6633. CERTAIN NEW TYPES OF INSTRUMENTS BASED ON SEMICONDUCTORS. V.N.Bogomolov.
Zh. tekh. Fiz., Vol. 26, No. 3, 693-4 (1956). In Russian.

Discussion of the possibility of application of the Hall effect to construct: (1) a square-law detector working in a large amplitude interval, (2) a linear detector which can detect several microvolts, and (3) a frequency analyser working both in the audio and the radio ranges.

537.311.33

6634. ELECTRONIC NOISE OF CdS SINGLE CRYSTALS AT HIGH ELECTRICAL FIELDS. K.W.Böer, U.Kümmel and G.Molgedey.
Ann. Phys. (Leipzig), Vol. 17, No. 6-8, 344-55 (1956). In German.

Results of experiments on noise in CdS as a function of frequency and applied field are reported and discussed in terms of fluctuations in the concentration of conduction electrons. C.A.Hogarth

537.311.33 : 541.135.4

6635. CHEMICAL INTERACTIONS AMONG DEFECTS IN GERMANIUM AND SILICON. H.Reiss, C.S.Fuller and F.J.Morin.
Bell. Syst. tech. J., Vol. 35, No. 535-636 (May, 1956).

Interactions among defects in Ge and Si have been investigated. The solid solutions involved bear a strong resemblance to aqueous solutions insofar as they represent media for chemical reactions. Such phenomena as acid-base neutralization, complex ion formation, and ion paring, all take place. These phenomena, besides being of interest in themselves, are useful in studying the properties of the semiconductors in which they occur. The article is a blend of theory and experiment, and describes developments during the past few years. A.

537.311.33

6636. ELECTRON MICROSCOPY OF ETCHED GERMANIUM SURFACES. J.W.Allen and K.C.A.Smith.
J. Electronics, Vol. 1, No. 4, 439-43 (Jan., 1956).

Certain features observed on etched germanium surfaces by the use of a scanning reflection electron microscope are described, and an interpretation of their appearance is suggested on the assumption that they mark the emergence of edge dislocations at the surface. A.

537.311.33

6637. IMPURITY BAND CONDUCTION IN GERMANIUM AND SILICON. E.M.Conwell.
Phys. Rev., Vol. 103, No. 1, 51-61 (July 1, 1956).

Attempts to establish the idea of impurity-band conduction on a firmer theoretical basis for germanium and silicon. Calculations by Baltensperger of energy bands arising from the impurities are adapted for these materials by replacing wave functions of impurity states with suitable hydrogenic approximations. These are used to estimate the concentration for which the impurity band substantially merges with the remainder of the conduction band, and this estimate is found to agree reasonably well with experiment. An estimate is also made of the range of concentrations for which the usual band type of theory might be applicable to electrons in the impurity band. It is found that approximately within this range the simple band theory does well for the impurity band. This, incidentally, highlights the necessity of taking into account conduction in impurity states for degenerate and near-degenerate samples even at relatively high temperatures. For concentrations lower than these a crude treatment of conduction is described which can account for the sharp increase in impurity band resistivity with decreasing impurity concentration, the importance of compensation in these samples, and even the order of magnitude of the resistivity. It does not, however, predict the correct temperature dependence for the resistivity, and a possible origin for this is suggested. The question of the sign of carriers in the impurity band is discussed, and it is shown that the sign reversal of thermoelectric power observed for the impurity band need not imply a change in sign of the effective mass. A.

537.311.33

6638. ELECTRICAL CONDUCTIVITY OF IRON SULFIDES SINGLE CRYSTALS AT THE TEMPERATURE RANGE OF α-TRANSFORMATION. T.Kamigaichi, T.Hihara, H.Tazaki and E.Hirahara.
J. Phys. Soc. Japan, Vol. 11, No. 5, 606-7 (May, 1956).

The conductivity was measured for differently orientated samples. A specimen cut with its length parallel to the c-plane showed high conduction and little anomaly at the temperature T_α, while a specimen with its length parallel to the c-axis showed low conduction on the low temperature side of T_α, and high conduction on the high temperature side, showing a remarkable anomaly at T_α. This anomaly corresponds to those of the magnetic, thermal and crystallographic properties.
W.Bardsley

537.311.33

6639. THE INFLUENCE OF IMPURITIES ON ELECTRICAL CONDUCTIVITY AND NON-LINEARITY OF CARBORUNDUM. L.I.Ivanov and V.I.Pruzhinina-Granovskaya.
Zh. tekh. Fiz., Vol. 26, No. 1, 220-31 (1956). In Russian.

537.311.33

6640. ELECTRICAL PROPERTIES OF STANNOUS TELLURIDE SnTe. K.Hashimoto and K.Hirakawa.
J. Phys. Soc. Japan, Vol. 11, No. 6, 716-17 (June, 1956).

The electrical resistivity ρ, Hall coefficient R, and thermoelectric power $d\theta/dT$, of SnTe, have been measured between 100°K and 1000°K. Data are summarized by table and graph. The temperature coefficients of ρ and R are positive for all samples over the whole temperature range. The change of sign of $d\theta/dT$ is found at about 250°C. The theoretical implications of the data are under consideration.
W.Bardsley

537.311.33

6641. SOME EXPERIMENTS ON, AND A THEORY OF, SURFACE BREAKDOWN. C.G.B.Garrett and W.H.Brattain.
J. appl. Phys., Vol. 27, No. 3, 299-306 (March, 1956).

Experiments on surface breakdown at reverse-biased germanium n^+p alloyed junctions are described, and the results related to a new model for surface breakdown that takes explicit account of semiconductor surface charge and fringing field. The experiments show (i) that surface breakdown, like body breakdown, is an avalanche process; (ii) that multiplication sets in first at a particular spot. The experiments serve also to confirm conclusions already reached from device experience: (i) that high breakdown voltage is promoted by that sign of surface charge which tends towards the formation of a "channel" over the material of the higher resistivity side, and low breakdown voltage by the opposite sign of surface charge; (ii) that the breakdown voltage is increased by surrounding the material by a medium of high dielectric constant. The theory accounts for all these observations and, leads when the calculations are carried out for an equivalent one-dimensional structure, to a quantitative prediction of the relation between breakdown voltage, surface charge, resistivity, and the dielectric constant of the surrounding medium. The evidence for the validity of this relation is discussed briefly. A.

537.311.33

6642. REVERSE CURRENT AND CARRIER LIFETIME AS A FUNCTION OF TEMPERATURE IN SILICON JUNCTION DIODES. E.M.Pell and G.M.Roe.
J. appl. Phys., Vol. 27, No. 7, 768-72 (July, 1956).

Earlier measurements of the reverse current and carrier lifetime in germanium have been extended to a series of silicon grown junction diodes, with measurements as a function of temperature between −190°C and 200°C. The lifetime reaches a plateau at low temperatures and can be explained in terms of the Hall–Shockley–Read recombination theory. The slope of $\log i_r$ v. $1/T$, the magnitude of i_r, and the slope of i_r v. V suggests that charge generation from centres about 0.5 eV deep is responsible for most of the reverse current in these samples up to temperatures well above room temperature.
A.

537.311.33

6643. A NOTE ON THE EXTENDED THEORY OF THE JUNCTION TRANSISTOR. T.Misawa.
J. Phys. Soc. Japan, Vol. 11, No. 7, 728-39 (July, 1956).

In obtaining the current-voltage relation of a junction transistor, one solves continuity equations for minority carriers with appropriate boundary conditions. There are two kinds of boundary condition which have been extended so as to apply to the high-injection level operation of a junction transistor. One is in terms of the electrostatic potential and the other is in terms of the quasi-Fermi levels. Taking into account the effect of the base spreading resistance, it is shown that they can be equivalently used in describing the d.c. and the low frequency performances of a junction transistor, but at medium frequencies the quasi-Fermi level approach is preferable. The small-signal a.c. conductances and capacitances which are related to the emitter junction have another correction factor which saturates to 1/2 at high injection levels. Conductances and capacitances are calculated as functions of the emitter current by using the latter boundary condition. A.

537.311.33

6644. OBSERVATIONS ON THE GROWTH OF EXCESS CURRENT IN GERMANIUM P-N JUNCTIONS. A.R.F.Plummer.
Proc. Phys. Soc. B, Vol. 69, Pt 5, 539-47 (May, 1956).

The excess current induced in a germanium p-n junction by water vapour was found to be time dependent, and three separate relaxation times were observed. By taking the time of growth into account the excess current was resolved experimentally into two components having linear and saturation relationships with the applied voltage. The surface structure assumed to be responsible for the saturation component does not develop until after a reverse voltage has been applied to the junction, and when the applied voltage is removed this surface structure disappears rapidly compared with the time of growth. The possibility that these components correspond to channel and surface leakage currents is discussed. A.

537.312 : 538.221 : 539.234

6645. MEASUREMENTS ON THE ELECTRICAL AND MAGNETIC PROPERTIES OF THIN FILMS AT LOW TEMPERATURE. A.Van Itterbeek.
J. Phys. Radium, Vol. 17, No. 3, 241-9 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

A brief report is given of the author's earlier measurements on the electrical and magnetic properties of nickel and iron films at low temperatures. Also the dependence of the resistance on the current together with the change of the resistance under the influence of a longitudinal magnetic field (parallel to the current) are briefly discussed. From these measurements the coercive force and its variation with temperature were determined. Earlier measurements on the superconductivity of tin film obtained by cathodic sputtering are also discussed. The essential properties of these films are: (1) The transmission temperature is higher than for bulk tin; (2) the values for the magnetic threshold field (H_c) are much higher than for bulk material. The same can be said from the critical value of the current density i_c. The Silsbee rule cannot be considered as valid for the relation between H_c and i_c. (3) By increasing the current, the form of the transition curve changes. The curves become sharper by increasing the current. (4) A large difference is found between the value of H_c — transversal parallel to the film and H_c — transversal perpendicular. New measurements have now been done on nickel and tin films condensed in vacuum (10^{-6} mm Hg) For some of the tin films the support was kept at a temperature of liquid air during the condensation. A special technique is described for the manipulation of those films. The tin film condensed at room temperature has the same transition temperature as the bulk metal, while the cooled film has a transition temperature which is much higher. The ratio between the transversal parallel threshold field and the transversal perpendicular one was studied. A strong variation is found for this ratio as a function of temperature. This can be explained by

nsidering the anisotropy of tin crystals. Also for the nickel lm measurements were made in the two field directions. A rge difference was found, which can be explained by con- dering the anisotropy factor for nickel crystals and by sup- osing that the films are formed of crystals with the (110) ane parallel to the plane of the film. A.

537.312.5

646. WAVELENGTH DEPENDENCE OF RADIATION-NOISE IMITS ON SENSITIVITY OF INFRARED PHOTODETECTORS. R.Platt.
Opt. Soc. Amer., Vol. 46, No. 8, 609-10 (Aug., 1956).

A theoretical equation is given for the sensitivities or gnal-to-noise ratios of infrared photodetectors as functions area and sensitive time and long-wavelength cutoff λ_0, ssuming the materials approach within comparable factors of ie fundamental limits set by radiation-noise from their sur- oundings at a given temperature. A.

537.312.5

647. SOME OBSERVATIONS ON THE THEORY OF PHOTO- ONDUCTIVITY IN THE LEAD SULPHIDE GROUP OF COM- OUNDS. C.Wood.
roc. Phys. Soc. B, Vol. 69, Pt 6, 613-18 (June, 1956).

Measurements have been made of the thermal activation nergy of PbSe evaporated films at various stages of sensitiz- tion treatment. For the highly sensitized film the thermal ctivation energy was found to be 0.29 eV, which corresponds o the photoconductive threshold. This result has been inter- reted as support for the "numbers" theory of photoconductiv- ty. A.

537.312.5

648. THEORETICAL CONSIDERATIONS GOVERNING THE HOICE OF THE OPTIMUM SEMICONDUCTOR FOR PHOTO- OLTAIC SOLAR ENERGY CONVERSION. J.J.Loferski.
. appl. Phys., Vol. 27, No. 7, 777-84 (July, 1956).

The theory of the photovoltaic effect is used to predict the haracteristics of a semiconductor which would operate with n optimum efficiency. The existence of such an optimum naterial results from the interaction between the optical pro- erties of the semiconductor which determine what fraction of he solar spectrum is utilized and its electrical properties hich determine the maximum efficiency of conversion into lectricity. Considerable attention is devoted to the effect of he forbidden energy gap (E_G) of the semiconductor. It is hown that atmospheric absorption causes a shift in the solar pectrum which changes the value of the optimum forbidden nergy gap between the limits $1.2\ eV < E_G < 1.6\ eV$. Further- nore, plausible departures of the diode reverse saturation urrent (I_0) from the parametric dependence predicted by hockley are considered, and it is shown that such departures educe the advantage of the optimum material over others in he range $1.1\ eV < E_G < 2.0\ eV$. The relation between E_G and he load impedance for maximum power transfer from the olar converter is discussed. Finally, I_0 is computed from he published values of the semiconductor parameters of three ntermetallic compounds, i.e., InP, GaAs and CdTe, and it is hown that the efficiencies predicted for these materials are reater than those predicted for other materials which have een proposed, i.e., Si, CdS, Se and AlSb. A.

537.312.5 : 539.11

6649. ELECTRONIC NOISE IN PHOTOCONDUCTING INSUL- ATORS. K.M. van Vliet and J.Blok.
Physica, Vol. 22, No. 6, 525-40 (June, 1956).

The noise caused by fluctuations in the number of free electrons is computed for photoconductors of the recombina- tion type. First a discussion of the fluctuations in the incident photon stream is given and the resulting photo-induced noise is calculated. It is shown that these fluctuations do not entirely determine the ultimate sensitivity; besides optical generations of free electrons other transitions also contribute to the noise. In a model without localized levels, such as traps, etc., the total noise is twice as large as the photo-induced noise, for all frequencies. Next a discussion is given for a photo-conduc- tor according to the model of Klasens–Schön. The spectrum of the photo-induced noise does not get the same shape as the total noise spectrum. In both spectra the same relaxation times occur but the partition over the various terms is differ- ent. Finally approximations are made for excitation of elec- trons from activator levels and from the valence band at low and high light intensities. A.

537.312.6 : 537.312.8

6650. TEMPERATURE HYSTERESIS OF THE GALVANO- MAGNETIC EFFECT. L.V.Kirenskiĭ and V.F.Ivlev.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 3, 419-21 (1956) In Russian.

The magnetic characteristics of a ferromagnetic are not single-valued functions of temperature for a given field but show dependence upon previous thermal history. Temperature dependence of magnetization in Ni and chrome–iron and tem- perature dependence of magnetostriction in Ni have been re- ported. The present paper describes a temperature hysteresis of electrical resistance with a ferromagnetic specimen in a steady magnetic field. The specimen was a Ni rod, d = 0.5 mm, l = 20 cm, included in a bridge circuit where it was compen- sated by a similar specimen. Fields of 12, 39 and 160 oersted were used and the specimen was taken automatically round a temperature cycle ranging from room temperature to the Curie point. Temperature and $\Delta R/R$ were recorded at right angles to give a magnetogram on a photographic plate.
C.R.S.Manders

537.312.62

6651. COMMENTS ON AN EXPERIMENT WITH PERSIST- ENT CURRENTS. M.H.Edwards and D.H.Rogers.
Canad. J. Phys., Vol. 34, No. 6, 619-21 (June, 1956).

Discusses an experiment by Collins (1955) on persistent currents in a superconducting lead tube and shows that his results agree with elementary theory. R.G.Chambers

537.312.62 : 539.152.2

6652. OBSERVATION OF NUCLEAR MAGNETIC RESO- NANCE IN SUPERCONDUCTING MERCURY. F.Reif.
Phys. Rev., Vol. 102, No. 5, 1417-18 (June 1, 1956).

The Knight shift of nuclear magnetic resonance in super- conducting colloidal Hg^{199} is found to be about 1.5% as com- pared with 2.4% in the normal metal. The breadth of the super- conducting resonance can be accounted for by field inhomo- geneity within the mercury spheres. At 1.45^0 K saturation effects indicate that the nuclear relaxation time is about 0.1 sec; no saturation effects were observed in the normal state at any temperature or in the superconducting state at 2.03^0 K. D.Shoenberg

537.312.62

6653. TRAPPED FLUX IN IMPURE SUPERCONDUCTIVE TIN. J.I.Budnick, E.A.Lynton and B.Serin.
Phys. Rev., Vol. 103, No. 2, 286-91 (July 15, 1956).

The percentage of trapped flux in cylindrical tin samples containing antimony, bismuth, or indium was measured, with particular regard to the effect of annealing. The flux was trapped by the application and removal of a large transverse magnetic field. The results do not confirm Pippard's conclu- sion that a marked change in flux trapping behaviour occurs at a critical concentration of impurity. Instead it is found that all samples, whether of high- or of low-impurity concentration, follow that same behaviour, namely that the percentage of trapped flux rises steeply near the transition temperature, and that this rise decreases monotonically with annealing time. In all cases in which this rise is discernible its temperature dependence is linear with the function $(1 - t^4)^{-1/2}$ up to $t \geq 0.98$, where $t = T/T_c$. It is believed that the binary specimens used as well as those used by Pippard have a substructure of fila-

ments of different concentration, which trap flux when the sample is insufficiently annealed. In support of this view extensive metallurgical evidence is cited for the existence of such a substructure, together with a crude measurement on two of the annealed specimens which showed that the magnetic field needed to restore resistance was much higher than the threshold field of the bulk material, and that this transition was quite broad. A.

537.312.62 : 535.375.54

6654. AN ATTEMPT TO DETECT COMBINATION (RAMAN) SCATTERING OF LIGHT BY A SUPERCONDUCTOR. M.S.Khaĭkin and V.P.Bykov.
Zh. éksper teor. Fiz., Vol. 30, No. 1, 191-2 (1956). In Russian.

If the excitation spectrum of a superconductor has an energy gap of order kT_c some of the quanta scattered from a superconductor might be modified in frequency by an amount of order kT_c/h; for lead this corresponds to a wavelength shift for the sodium D lines of about 2 A. It was established that in fact no such satellite occurred in the spectrum of the scattered light with an intensity greater than 10^{-7} that of the unmodified scattered light. D.Shoenberg

537.312.62

6655. INFLUENCE OF HYDROSTATIC PRESSURE ON THE SUPERCONDUCTING PROPERTIES OF THE α AND β MODIFICATIONS OF Bi_2Pd. N.E.Alekseevskiĭ and I.I.Lifanov.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 405-6 (1956). In Russian.

The water bomb technique was used and dT_c/dp was found to be -2.5×10^{-11} and -5.6×10^{-11} °K.dyne^{-1}.cm^2 for the α and β modifications respectively. The shift of T_c was not completely reversible for the β modification and dT_c/dp for it may be as low as -3.5×10^{-11}. D.Shoenberg

537.312.7

6656. CONDUCTIVITY MODULATION OF THIN EVAPORATED SILVER FILMS UNDER AN ELECTROSTATIC FIELD. A.Deubner and K.Rambke.
Ann. Phys. (Leipzig), Vol. 17, No. 6-8, 317-28 (1956). In German.

Experimental investigation of the resistance of thin films of Ag in the range of 4 to 19 microns thickness as a function of thickness, and as a function of capacitively applied electric fields at a frequency of 70 c/s. The relative change in resistance was found to be a linear function of the applied field for both positive and negative fields. The effects decreased with time. C.A.Hogarth

537.312.7 : 539.234

6657. MODULATION OF THE CONDUCTIVITY OF A THIN TELLURIUM LAYER BY AN ELECTRIC FIELD. L.Godefroy.
J. Phys. Radium, Vol. 17, No. 3, 278-82 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

The temperature dependence of this modulation gives some information about the energy of the surface states. A.

537.312.8

6658. ON THE THEORY OF GALVANOMAGNETIC PHENOMENA IN METALS. I.M.Lifshits, M.Ya.Azbel' and M.I.Kagonov.
Zh. éksper. teor. Fiz., Vol. 30, No. 1, 220-2 (1956). In Russian.

It is shown that in the limit of very strong magnetic field strengths some elements of the conductivity tensor are independent of the scattering mechanism, and that in some cases it is possible in principle to deduce the topology of the Fermi surface from experimental data. J.M.Radcliffe

537.32

6659. ON A THERMOELECTRIC EFFECT EXHIBITED BY POWDERED CUPRIC OXIDE. M.Perrot, G.Peri, J.Robert, J.Tortosa and A.Sauze.
C.R. Acad. Sci. (Paris), Vol. 242, No. 21, 2519-22 (May 23, 1956). In French.

Experiments with the system Cu/CuO/Cu. C.A.Hogarth

537.32 : 539.23

6660. CONTRIBUTION TO THE STUDY OF THE THERMOELECTRIC PROPERTIES OF THIN ALUMINIUM FILMS. J.Savornin and F.Savornin.
J. Phys. Radium, Vol. 17, No. 3, 283-6 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

The thermoelectric properties of thin aluminium films evaporated on glass bases have been studied. The junctions of two Constantan-copper thermocouples are fastened on both ends of the layer; a potentiometer indicates the e.m.f. of the aluminium/copper thermocouple. The samples thicker than 100 millimicrons show about the same thermoelectric power as the massive metal itself. A non-important "thermal evolution" appears sometimes. The thermoelectric voltage of films, the thickness of which is comprised between 10 and 100 millimicrons, rises suddenly up to 0.1 V, for temperatures increasing with the thickness of the sample. A similar rise is observed when the thin film is connected to silver wires. A.

537.32 : 539.23

6661. VARIATION OF THERMOELECTRIC POWER OF AN ALUMINIUM/SILVER COUPLE BY MODIFICATION OF THE HOT SOLDERING UNDER THE EFFECT OF A CHEMICAL REACTION OR BY THE INTRODUCTION OF CONDUCTORS OR SEMICONDUCTORS. A.Aron.
J. Phys. Radium, Vol. 17, No. 3, 287-9 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

The thermoelectric power from the thermocouple silver/aluminium used in comparatively thick films, is equal to 5.45 microvolts/degree between 150° and 380° C. It is increased if the hot soldering is eroded by iodine or if a thin layer of antimony is introduced between the silver and aluminium. The erosion by bromine or the interposition of conductors or semiconductors provokes a variable increase: the thermoelectric power changes then in direct ratio with the rise in temperature.

537.32 : 537.311.33

6662. INVESTIGATION OF THE PELTIER EFFECT AND OF THE THERMAL E.M.F. IN GERMANIUM. M.Shtenbek and P.I.Baranskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 3, 683-5 (1956). In Russian.

537.322.1

6663. CASCADING OF PELTIER COUPLES FOR THERMOELECTRIC COOLING. B.J.O'Brien, C.S.Wallace and K.Landecker.
J. appl. Phys., Vol. 27, No. 7, 820-3 (July, 1956).

The cooling of a single thermoelectric junction is limited to a certain temperature difference by the inherent properties of the elements used. Altenkirch gave a theoretical treatment of the single couple and showed a way to overcome the limitation on cooling by using a number of thermocouples in thermal cascade. Such an arrangement was constructed by Turrettini and shown to work. A simplified form of Altenkirch's theory is presented and a form of cascade which is simpler and more efficient than that of Turrettini is described and experimental results are given. A two-stage cascade of elements limited to 11° C cooling as a single couple reached 15°C cooling while rather heavily loaded by lack of adequate thermal insulation. A good agreement with theory is obtained for the behaviour of this cascade. It is shown that such a cascade is in theory more efficient than a single couple under all circumstances. A.

537.363

64. MICROELECTROPHORESIS OF QUARTZ PARTICLES HYDROCHLORIC ACID SOLUTIONS. M.Baruch.
R. Acad. Sci. (Paris), Vol. 242, No. 19, 2347-50 (May 7, 56). In French.

The electrophoretic displacement of quartz particles of 2-2 μ dia. was investigated in a cell having walls of the same aterial, two Pt electrodes and two probing electrodes of gCl. The particles were suspended in a solution of HCl of rying concentration. If the mobilities in (μ per sec)/(V per n) are plotted against the log of concentration between 10^{-3} d 10^{-6}, straight lines starting from a common point of the scissa are found for electro-osmotic and electrophoretic obilities, the slope of the former being about 3 times larger an that of the latter. R.Neumann

ELECTRIC DISCHARGES 537.52

537.521

665. CHARACTERISTICS OF PROBES AT POSITIVE OTENTIAL AND MEASUREMENT OF THE GAS DENSITY N A DISCHARGE. B.N.Klyarfel'd, A.A.Timofeev, .A.Neretina and L.G.Guseva.
h. tekh. Fiz., Vol. 25, No. 9, 1581-95 (1955). In Russian.

When the p.d. between a positive probe and plasma is ncreased, the VA-characteristic reveals existence of an ssisted discharge region around the probe and a self-sustain-d discharge region near anode, with a discontinuous transit-on zone between them. P.d. between plasma and positive robe at which the layer around the zone breaks down increas-s with decreasing gas density and increasing discharge cur-ent. This relation may be used for measuring the gas density n the range of an intense discharge.
Electrical Research Association

537.523.5 : 537.311.4 : 621.3.064.241

666. BRIDGE AND SHORT ARC EROSION OF COPPER, ILVER, AND PALLADIUM CONTACTS ON BREAK.
.B.Ittner, III.
appl. Phys., Vol. 27, No. 4, 382-9 (April, 1956).

The bridge and short arc erosion of copper, silver and alladium contacts and a number of alloys of these materials as been measured as a function of the break current in a rcuit containing only a small amount of inductance. A theory presented for calculating the arc duration, the charge assed by the arc, and the arc energy. Under the described onditions the total charge passed in the arc as well as the arc nergy is proportional to the square of the rupture current. nort arc erosion in such a circuit will show, therefore, the ame current dependence as bridge transfer. While it is pos-ble to effectively separate the two types of erosion by con-olling the circuit inductance evidence is presented to indicate at the two processes may not be completely independent.
A.

537.525

667. THE DISPLAY OF LOGARITHMIC LANGMUIR ROBE CHARACTERISTICS ON A CATHODE-RAY OSCILLO-RAPH. A.R.Johnston.
rit. J. appl. Phys., Vol. 7, No. 7, 266-7 (July, 1956).

A new method for displaying Langmuir probe characteris-cs on a persistent screen cathode-ray oscillograph is des-ribed. The cathode-ray oscillograph traces are recorded on icrofilm. A comparison is given of the values of some dis-harge parameters obtained by this method and those found by easuring the probe current with a galvanometer. A.

537.525

668. ON THE THEORY OF A SPHERICAL PROBE IN LASMA. Yu.M.Kagan and V.I.Perel'.
okl. Akad. Nauk SSSR, Vol. 95, No. 4, 765-8 (1954). In ussian.

Theory of a spherical probe in low pressure plasma discharges with the probe acting as a sink for charged particles. Plasma is assumed to be infinite i.e. in practice the probe is small compared with the dimensions of the discharge tube and the mean free path of the particles. Comparison with the Langmuir theory is made.

537.525

6669. ON THE THEORY OF LANGMUIR PROBES.
Yu.M.Kagan and V.I.Perel'.
Zh. éksper. teor. Fiz., Vol. 29, No. 2(8) 261-3 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 326-7 (March, 1956).

A note on the Langmuir theory of the spherical (negative potential) plasma probes. Some corrections to the previous work (see preceding abstract) are now found to be necessary.
J.D.Craggs

537.525 : 545.822

6670. REACTIONS IN GAS DISCHARGES WITH THE SPECTRO-CHEMICAL DETECTION OF NON-METALS THROUGH EXCITATION WITH ULTRA-SHORT WAVES, FOLLOWING (THE METHOD OF) GATTERER AND FRODL . D.von Bezold.
Z. angew. Phys., Vol. 8, No. 6, 269-81 (May, 1956). In German.

Gives a detailed account of the method [Gatterer and Frodl, Richerche Spectroscopiche, Vol. 1, 201 (1946)] and of the electrical and optical properties of low-pressure pulsed ring discharges in mixtures of helium and argon, and also with NaCl and KCl in argon and air. Discharge instability and the effects of external magnetic field are considered.
C.G.Morgan

537.525 : 621.3.015.5

6671. PRESENT-DAY IDEAS CONCERNING THE MECHANISM OF ELECTRICAL BREAKDOWN IN HIGH VACUUM.
L.V.Tarasova.
Uspekhi fiz. Nauk, Vol. 58, No. 2, 321-46 (1956). In Russian.

Review of experimental work on the effect of different metals as electrodes, mechanism of tearing out particles from an electrode, effects with small interelectrode distance and moderately high voltage, effects with large separation and high applied voltage. The author concludes it is not possible to give a satisfactory general account of phenomena. 54 refs.
C.R.S.Manders

537.525.3 : 537.525.72 : 537.525.8

6672. A REMARK ON THE EXCITEMENT OF THE ELECTRODES WHEN A POSITIVE JOSHI EFFECT INVERSION IS OBSERVED UNDER CONTINUOUS DISCHARGE. B.Sujak.
J. Phys. Soc. Japan, Vol. 11, No. 6, 719-20 (June, 1956).

A brief account of surface effects, with reference to alkali-halide layers, in a.c. corona ("ozonizer") discharges subjected to external irradiation with visible light.
J.D.Craggs

537.525.4

6673. THE INFLUENCE OF THE (ELECTRODES) SURFACE STATE IN ELECTRICAL DISCHARGES IN A VACUUM.
R.Arnal.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2308-9 (May 9, 1956). In French.

Briefly discusses surface effects in relation to low pressure electrical breakdown. The effect of "ageing", i.e. to increase the breakdown voltage, is mentioned. J.D.Craggs

537.525.5 : 621.314.653

6674. THE FIRING TIME OF THE ANODE OF AN IGNITRON.
N.Yamada, Y.Ikeda and Y.Iida.
J. Inst. Elect. Engrs Japan, Vol. 75, 465-70 (May, 1955). In Japanese.

The firing time, which is important in control systems using ignitors, varies with mercury-vapour density, anode voltage and the dimensions of the arc path. Measurements

were made on an ignitron with glass envelope and four anodes, using a high-speed c.r.o. The effects of ions and electrons with wide and narrow arc paths and of the conformation of the electric field between anode and cathode are studied.

H.G.M.Spratt

537.525.5

6675. THE LANGMUIR PARADOX IN DISCHARGE PLASMAS. H.Martin and K.G.Emeléus.
Nature (London), Vol. 177, 943-4 (May 19, 1956).

Experiments in which oscillatory energy is withdrawn from low-pressure arcs through the main electrodes and probes to tuned detectors, give results for the fluctuations present, which are thought to be comparable with those obtained by previous investigators using an electron beam probe (Abstr. 1271/1956). It is suggested that a Langmuir paradox need not necessarily arise near a hot cathode. J.Dutton

537.525.5

6676. DEFORMATION OF THE ARC COLUMN IN RAREFIED GASES AT HEAVY CURRENTS. G.G.Timofeeva and V.L.Granovskiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 477-87 (1956). In Russian.

The phenomena taking place in arcs in Hg, H_2, A and Kr were investigated at a pressure of about 10^{-4}-10^{-3} mm Hg and at arc currents, i, up to 2000 A. A mobile probe was used in the investigation. It was found that the halfwidth of the arc column decreases by about 30% when i increases up to 100 A. Further increase of the arc current leads to the appearance of oscillations of the probe current which gradually increase; at higher currents voltage oscillations in the arc appear and finally oscillations of the arc current with a mean frequency $f = 10^4$ - 10^5 c/s are observed. Oscillograms of the currents in two identical probes located in symmetrical positions indicate that these oscillations can be interpreted as being the result of random movement of the compressed arc column over the cross-section of the tube. The compressed arc column can be observed visually or photographically at current pulses i = 500-2000 A and duration of 1-10 μsec. The column is compressed into a thin spiral pressed to the walls of the tube. By using a rotating photographic camera it was found that for current pulses of the order of 10^2-10^3 μsec the arc is also compressed and makes a large number of transverse transitions in the tube. Compression and deformation of the arc column are due to electrodynamical causes while the movement is due to gas-dynamic forces. A.

537.525.8

6677. THE LONGITUDINAL GRADIENT OF THE POSITIVE COLUMN OF THE ARGON DISCHARGE IN A WIDE TUBE. K.Rademacher and K.Wojaczek.
Ann. Phys. (Leipzig), Vol. 17, No. 6-8, 293-7 (1956). In German.

Reports probe measurements of the longitudinal gradient in pure argon at pressures between 0.8 and 4 mm Hg for currents between 0.15 and 5 A in a tube of 12 cm diameter.

J.Dutton

537.525.8

6678. THE NORMAL CATHODE FALL IN A.C. GLOWS. E.W.Godbole.
Canad. J. Phys., Vol. 34, No. 6, 616-19 (June, 1956).

Discusses measurements of the normal cathode fall in 50 c/s discharges in hydrogen between Pt or Al electrodes (0.1-7 mm Hg pressure) using a probe method. The effect of external irradiation with "visible" light on the cathode fall was determined. There is a brief discussion. J.D.Craggs

537.527.5

6679. ON POTENTIAL MEASUREMENTS WITH MOVING PROBES IN HIGH PRESSURE ARCS. G.Müller and W.Finkelnburg.
Z. angew. Phys., Vol. 8, No. 6, 282-7 (May, 1956). In Germ

A method giving oscillographic representation of the potential distribution across an arc column is described.

C.G.Morga

537.5

6680. INFLUENCE OF MOLECULAR STRUCTURE UPON THE ELECTRIC STRENGTHS OF LIQUID HYDROCARBONS. A.H.Sharbaugh, R.W.Crowe and E.B.Cox.
J. appl. Phys., Vol. 27, No. 7, 806-8 (July, 1956).

The electric strengths of straight-chain liquid alkanes are known to increase with increasing molecular chain lengt The introduction of branches in the hydrocarbon chain, on th other hand, results in a reduction in strength. In an effort t gain a clearer understanding of this behaviour investigations have been extended to include hydrocarbons of more complex molecular structure and results are presented for benzene a a series of alkyl benzenes. The strengths of those members in which the alkyl group is unbranched bear a nearly linear relationship to the molecular weight, not unlike that observe for the n alkanes. Furthermore, branching of the alkyl side chain again results in a decrease of electric strength. An attempt is made to interpret the results in terms of a simple model. A

537.529 : 548.7 : 621.3.015.

6681. DIELECTRIC BREAKDOWN OF X-RAY COLOURED CRYSTALS. Y.Inuishi and T.Suita.
J. Inst. Elect. Engrs Japan, Vol. 75, 378-82 (April, 1955). In Japanese.

The crystals studied are alkali-halide crystals. The breakdown voltage of coloured KCl was obtained as a function of ambient temperature, waveform, intensity of light illumination and the density of F-centres. The time lag of breakdown was also measured. The remarkable lowering of the d.c. breakdown voltage when the crystal is illuminated by visible light seems to be explained by von Hippel's theory of photoconduction, i.e. increase of the cathode field due to the pos. space charge of the ionized F-centres. Time lag, thickness and variation of breakdown voltage are consistent with von Hippel's theory. H.G.M.Spratt

X-RAYS 537.531

537.531 : 548.73

6682. THE DEPENDENCE OF THE X-RAY SPECTRUM ON CHEMICAL BINDING. (INVESTIGATION OF THE Co $K\beta_1$ LINE OF VARIOUS COBALT COMPOUNDS BY SIMPLE MEANS). H.Herglotz and E.Deimel.
Acta phys. Austriaca, Vol. 10, No. 1-2, 127-41 (1956). In German.

A back-reflection camera was used to detect very small differences in wavelengths emitted by various cobalt compounds. A number of alloys whose lattice parameters make them suitable for obtaining high-angle back reflections with cobalt $K\beta_1$ radiation are listed. A.R.Stokes

537.531

6683. THE PURE FORMS OF X-RAY SPECTRA. M.A.Blokhin.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 1, 33-6 (1956). In Russian.

It is shown theoretically that, having found the parameter of distortion (assumed dispersive) occurring in the apparatus from a standard line near the line under examination, corrections can be applied to the form of the latter by resolving it into a Fourier series and correcting each term separately. This procedure is demonstrated on a synthetic example.

A.L.Mackay

537.531

584. CALCULATION OF THE DISTORTION OF X-RAY SPECTRA INTRODUCED BY THE APPARATUS. M.A.Blokhin. Dokl. Akad. Nauk SSSR, Vol. 107, No. 2, 229-32 (1956). In Russian.

The method of correction described in the preceding abstract is extended to cover distortions of arbitrary form. It applies both to emission and absorption spectra.

A.L.Mackay

537.531 : 535.33

585. THE SOFT X-RAY SPECTROSCOPY OF THE SOLID STATE BY THE ELECTRONIC DIFFERENTIATING METHOD: ALUMINIUM L_3. G.Shinoda, T.Suzuki and S.Kato. J. Phys. Soc. Japan, Vol. 11, No. 6, 657-61 (June, 1956).

A method was developed of observing soft X-ray emission spectra directly on the screen of a cathode-ray oscilloscope. Soft X-rays emitted from metals were detected by a photoelectric device which works under retarding voltages having saw-tooth wave form. The photoelectric current was differentiated three times by electronic differentiating circuits. The saw-tooth wave voltage corresponds to the reciprocal of wavelength, while the differentiated photoelectric current represents the intensity of soft X-ray emission. Using this method we obtained the emission spectra in about 1/100 sec exposure without serious contamination of the anticathode. As an example, the structure of the L_3 emission spectrum of Al was studied. A.

537.531

6686. THE INTENSITY OF EMISSION OF CHARACTERISTIC X-RADIATION. C.R.Worthington and S.G.Tomlin. Proc. Phys. Soc. A, Vol. 69, Pt 5, 401-12 (May, 1956).

A method for calculating the X-ray emission intensity from thick targets as a function of the target atomic number, accelerating voltage and angle of emission has been devised, and applied to the emission of the radiation from Ag, Cu, Cr and Al. These calculations involve a discussion of the penetration of electrons into metals and a convenient expression for the range of low energy electrons has been obtained. The theoretical emission of Cu Kα radiation has been compared with some experimental observations on emission at small angles to the target surface, with results which are satisfactory within certain limits. The bearing of these results on the design of X-ray sources, particularly for low-angle diffraction apparatus is discussed. A.

537.531.08 : 536.62

6687. A CALORIMETER FOR MEASURING THE POWER IN A HIGH-ENERGY X-RAY BEAM. J.McElhinney, B.Zendle and S.Domen. J. Res. Nat. Bur. Stand., Vol. 56, No. 1, 9-16 (Jan., 1956).

The design and calibration of a calorimeter to measure the power in X-ray beams having peak energies between 1 and 180 MeV are described. The calorimeter included two thermally balanced lead cylinders, 4 cm dia. by 7.5 cm long, one irradiated by an X-ray beam. The lead cylinder was large enough to absorb almost completely the X-ray beam. The absorbed energy resulted in an unbalance of temperature of the two cylinders, which was measured by the change in resistance of embedded thermistors. A.

537.531.85 : 548.732

6688. INTENSITY OF X-RAY SCATTERING BY THE COMPTON EFFECT IN ALUMINIUM. H.Curien and C.Déroche. Bull. Soc. Franç. Minéral. Crist., Vol. 79, No. 1-3, 102-17 (Jan.-March, 1956). In French.

The Compton-effect scattering of polycrystalline aluminium was measured by a method in which a filter is used to pass the Compton scattered X-rays but absorb the thermal-vibration scattering. The measured intensity of scattering is a little smaller than the theoretical value. A.R.Stokes

537.533

6689. EXCITATION OF SYNCHROTRON OSCILLATION DUE TO ELECTRON RADIATIVE FLUCTUATIONS. A.A.Kolomenskiĭ. Zh. éksper. teor. Fiz., Vol. 30, No. 1, 207-9 (1956). In Russian.

It is shown that in a strong-focusing synchrotron, even for very high values of the final energy of the electrons (5 to 10 BeV), the correction due to radiative fluctuations is so small as not to disturb the acceleration process.

G.Martelli

537.533.2

6690. ON EXPERIMENTAL TESTING OF THE WAVE-MECHANICAL THEORY OF FIELD ELECTRON EMISSION. R.Haefer. Acta phys. Austriaca, Vol. 10, No. 1-2, 149-61 (1956). In German.

Previous uncertainties in the values of field strength at electrode points are avoided by using a recently developed method by Drechsler and Henkel (see Abstr. 318/1955). This permits correction factors to be applied to previously determined field emission constants. C.G.Morgan

537.533.2 : 537.534.8 : 537.525

6691. AUGER EJECTION OF ELECTRONS FROM BARIUM OXIDE BY INERT GAS IONS AND THE CATHODE FALL IN THE NORMAL GLOW DISCHARGES. Y.Takeishi. J. Phys. Soc. Japan, Vol. 11, No. 6, 676-89 (June, 1956).

Total yield, γ, and energy distribution were calculated for electrons ejected from BaO by inert gas ions, on the basis of the theory of Auger neutralization. The method used was similar to Hagstrum's method for tungsten. Total electron yields, γ, were found to be 0.481, 0.480, 0.476, 0.474 and 0.471 for He^+, Ne^+, A^+, Kr^+ and Xe^+ ions of several electron volts respectively. The electrons ejected from BaO had an unexpectedly high energy and a narrow distribution in comparison with those from tungsten observed by Hagstrum. In the case of A^+, the calculated value of γ is in good agreement with Varney's measurements, and the high energy of ejected electrons is just what Varney expected. The cathodic phenomena (cathode fall, width of Crookes' dark space, and current density) in the normal glow discharges were observed for He, Ne, A and Xe gases with BaO-coated cathode and tungsten, and were interpreted by von Engel and Steenbeck's theory using the calculated values of γ for BaO and the observed one by Hagstrum for tungsten. A.

537.533.2

6692. ELECTRON EMISSION FROM PLASTICALLY DEFORMED ZINC CRYSTALS. J.Lohff. Z. Phys., Vol. 145, No. 4, 504-7 (1956). In German.

Continuation of previous work (Abstr. 6203/1955). Electron emission from single crystals of zinc at pressures $\sim 2 \times 10^{-8}$ mm Hg was measured with a secondary electron multiplier. Emission showed a temporal decay effect and was independent of pressure of oxygen up to 10^{-4} mm Hg.

C.G.Morgan

537.533.3 : 537.543

6693. SPACE CHARGE EFFECTS IN DENSE, VELOCITY-MODULATED ELECTRON BEAMS. M.Weinstein and H.M.Von Foerster. J. appl. Phys., Vol. 27, No. 4, 344-6 (April, 1956).

By assuming the bunching process of electrons in the drift region of a klystron as being space periodic, rather than time periodic, it is possible to describe the debunching mechanism in a finite diameter beam on a large signal basis. It is shown that such beams have a discrete spectrum of oscillations with the plasma frequency as series limits. This makes it impossible to assign a unique bunching parameter to all electrons.

These results check with a velocity-phase analysis of high-density electron beams carried out with a beam analyser at a frequency of 3000 Mc/s. A.

537.533.3

6694. AREA SOURCES OF LOW-ENERGY ELECTRONS FOR ELECTRON OPTIC STUDIES. R.J.Schneeberger.
Rev. sci. Instrum., Vol. 27, No. 4, 211-15 (April, 1956).

Ordinarily, the performance of electron lenses in electron imaging devices employing photoelectric surfaces can be evaluated only after sealed-off vacuum tubes containing the processed photoelectric surfaces are made. After processing, such tubes cannot be opened to air for alterations without destroying the photoelectric surfaces. Three distinct types of structures for providing area sources of low-energy electrons simulating photoelectric sources are discussed. These structures can be inserted in demountable vacuum systems and are not destroyed by subsequent exposure to air. A.

537.533.3

6695. STEREOSCOPIC REFLECTION ELECTRON MICROSCOPY. D.E.Bradley, J.S.Halliday and W.Hirst.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 484-5 (April, 1956).

The method for obtaining stereoscopic pairs of micrograms in the reflection electron microscope is discussed and deductions made for the correct angles of specimen rotation required to give the correct impression. M.E.Haine

537.533.33

6696. A RIGOROUSLY SOLUBLE MODEL FOR CYLINDRICAL IMMERSION ELECTRON LENSES. H.Grümm.
Optik, Vol. 13, No. 6, 277-88 (1956). In German.

Electron paths through an analytical potential distribution similar to that of a two-dimensional immersion lens are calculated rigorously. Criteria are established to distinguish between operation as lens and mirror respectively. Expressions are given for paraxial focal properties. A.E.I. Research Laboratory

537.533.331

6697. INVESTIGATION OF NONROTATIONALLY SYMMETRICAL ELECTROSTATIC ELECTRON OPTICAL LENSES. R.F.Whitmer.
J. appl. Phys., Vol. 27, No. 7, 808-15 (June, 1956).

Electrostatic lenses which are nonrotationally symmetric, constant in time, free of space charge, and in which the electrostatic potential along the axis of the lens does not fall to the cathode potential are investigated. In general nonrotationally symmetric lenses suffer from first-order distortion and astigmatism. A method is given for determining lenses of the assumed symmetry which are free of these first-order aberrations. This is accomplished by deriving an imaging relationship between $\Phi_2(z)$, an arbitrary field parameter introduced from the assumed field symmetry, and $\Phi(z)$, the rotationally symmetric component of the axial potential distribution, from the paraxial ray equations. The equations for the spherical aberration of such a lens are derived by standard methods. A method is given for finding lenses of reduced aberration and specific examples are discussed. A.

537.533.335

6698. PREDETERMINATION OF MAGNETOSTATIC ELECTRON OPTICAL IMAGING SYSTEMS. B.von Borries and F.Lenz.
Optik, Vol. 13, No. 6, 264-76 (1956). In German.

A study has been made of magnetic lenses for the electron microscope in which a permanent magnet provides the excitation. The problem is to design the magnetic circuit for maximum refractive power in the lens, but using a minimum amount of permanent magnetic material. The calculations are illustrated by practical examples of successful permanent magnet lenses. An arrangement is described for varying the strength of such a lens by means of a mechanically operated soft iron shunt. A.E.I. Research Laboratories

537.533.

6699. PULSED T-F EMISSION ELECTRON PROJECTION MICROSCOPY. W.P.Dyke and J.P.Barbour.
J. appl. Phys., Vol. 27, No. 4, 356-61 (April, 1956).

Pulse electronic techniques extend the advantages of field emission microscopy to desirable experimental conditions not attained with steady-state fields. A visually continuous "motion picture" emission pattern enhances the study of transient cathode mechanisms while holding negligible the adverse effects of large electrostatic forces on both cathode stability and mechanisms under study. Observation is extended to elevated cathode temperatures, to higher environmental gas pressures, and to low tensile strength cathode materials; at the same time, excellent cathode electrical stability is maintained. Several mechanisms are illustrated, including condensation, volume diffusion, surface migration and cathode blunting.

537.533

6700. ANALYSIS OF NOISE IN ELECTRON BEAMS. F.N.H. Robinson and H.A.Haus.
J. Electronics, Vol. 1. No. 4, 373-84 (Jan., 1956).

A general discussion of noise in linear systems, where many modes carrying both positive and negative power can propagate, is given. Matrix notation is used and it is found that an arbitrary noise process can be represented by a process with independent excitation of each mode together with lossless transducer. An expression for the noise figure of arbitrary beam type amplifiers is also obtained. This noise figure depends only on the least noise content of a negative power mode in the fundamental representation of the noise process.

537.533.7 : 537.534.7 : 538

6701. MOTION OF A CHARGED PARTICLE IN AN OPTICALLY ACTIVE ANISOTROPIC MEDIUM. I. A.G.Sitenko and A.A.Kolomenskiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 511-17 (1956). In Russian.

The Fourier method is applied to determine the electromagnetic field components and the total energy loss of a charged particle moving in an optically active anisotropic medium.

537.533.

6702. THE SCATTERING OF 121 keV ELECTRONS AND POSITRONS. L.J.Tassie.
Austral. J. Phys., Vol. 9, No. 1, 54-60 (March, 1956).

The angular distribution of the single scattering of 121 k positrons in gold and of 121 keV electrons and positrons in a gon is calculated for an exponentially screened field. The single scattering distributions are integrated numerically to give mean square angles of multiple scattering, and hence t percentage difference in the r.m.s. angles of multiple scatte ing of electrons and positrons.

537.533.74 : 539.152.

6703. ELECTRON DOUBLE SCATTERING BY NUCLEAR MAGNETIC MOMENTS. R.G.Newton.
Phys. Rev., Vol. 103, No. 2, 385-9 (July 15, 1956).

Polarization effects in the scattering of high-energy electrons by charges and magnetic moments are discussed. A double scattering experiment using targets with lined-up nuclear spins should be a sensitive means of obtaining information about a possible difference in the charge and magnetic moment distributions of nuclei.

537.533.74 : 537.534.

6704. SCATTERING OF HIGH ENERGY ELECTRONS BY ELECTRONS AND POSITRONS. A.A.Abrikosov.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 544-50 (1956). In Russian.

Scattering of charged particles with energies $\pi/e \ll \ln(E/m) \ll \pi/e^2$ is considered. It is shown that the cross-section for electron–electron scattering which is accompanied by an arbitrary radiation does not differ from the value obtained by the zero approximation treatment. A different value of the cross-section is obtained for positrons scattered through small angles by electrons. This difference was determined by solving the integral equation. A.

537.533.75

6705. FORMULAE FOR THE MEAN LOSSES OF ENERGY IN COLLISIONS OF SLOW ELECTRONS MOVING IN DIATOMIC GASES. L.G.H.Huxley.
Austral. J. Phys., Vol. 9, No. 1, 44-53 (March, 1956).

Formulae are derived for the mean losses of energy in collisions with molecules by electrons moving in a steady state of motion in a diatomic gas in an electric field. Although the theory is incomplete and crude, yet the formulae describe the experimental measurements closely in the smaller ranges of electronic energy. Such formulae find application in the theory of radio wave interaction. A.

537.533.75

6706. THE CHARACTERISTIC ENERGY LOSSES OF MEDIUM VELOCITY ELECTRONS IN Se LAYERS OF VARIOUS STRUCTURES. H.Friedmann.
Z. Naturforsch., Vol. 11a, No. 5, 373-9 (1956). In German.

The characteristic energy losses of 6 kV primary electrons in thin Se layers were measured with a 70° magnetic spectrograph. The structures of the layers were determined by electron diffraction and electron microscopy and their thickness obtained with the Tolansky technique. The maximum energy loss depended far more on the layer thickness and scattering angle than on the structure. The structural effect on the energy losses was about 0.1 eV, the limit of experimental accuracy. A rapid decrease in the inelastic differential scattering cross-section occurs with decreasing scattering angle, independent of the structure. J.Franks

537.533.75

6707. NEW RESULTS ON THE LOSS OF ENERGY BY ELECTRONS IN METALLIC FILMS: INTERPRETATION. B.Gauthe.
C.R. Acad. Sci. (Paris), Vol. 242, No. 22, 2634-6 (May 28, 1956). In French.

The electrostatic spectrograph described in Abstr. 11110 (1954) has been used for determining energy loss in layers, about 300 A thick, of Be, Ge, Cu, Au, Ag. The meaning of the results is discussed. A.H.W.Beck

537.533.75 : 537.534.75

6708. ON THE ENERGY LOSS AND SPECIFIC IONIZATION OF A RELATIVISTIC PARTICLE IN A POLARIZABLE MEDIUM. I. P.Budini and L.Taffara.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 23-45 (July, 1956).

The average total energy loss of a particle on passing through a polarizable medium has been calculated by introducing into the theory of Fermi an expression for the dielectric constant which is apt to represent both the dispersive and absorptive properties of the medium. The average total energy may then be divided into the average energy lost as excitation, Cherenkov radiation and primary ionization of the atoms of the medium. The effect has been calculated of the polarizability of the medium on the number of ions generated by the ionizing particle per unit length and on the number of events in which an atomic electron has been emitted with energy greater than a certain threshold energy. These numbers show a logarithmic increase at relativistic energies and a subsequent saturation caused by the polarizability of the medium, both dependent on the threshold energy. A.

537.533.75

6709. PENETRATION OF ELECTRONS IN ALUMINUM OXIDE FILMS. J.R.Young.
Phys. Rev., Vol. 103, No. 2, 292-3 (July 15, 1956).

The practical range of low-energy electrons in thin Al_2O_3 films has been measured. Films ranging in thickness from 85 to 5000 A were investigated. Results are in close agreement with the predictions of Bethe and the results obtained by Hoffmann for 1000-3000 A Al_2O_3 films. The practical range–energy relation obtained was found to be $R = 0.0115E^{1.35}$, where R is expressed in mg/cm^2 and E in keV. A.

537.533.75 : 537.534.75

6710. DENSITY EFFECT FOR THE IONIZATION LOSS IN VARIOUS MATERIALS. R.M.Sternheimer.
Phys. Rev., Vol. 103, No. 3, 511-15 (Aug. 1, 1956).

The reduction in the ionization loss of charged particles due to the polarization of the medium has been calculated using the mean excitation potentials recently determined by Caldwell. Values of the coefficients of an approximate analytic expression for the density effect correction have been obtained for a number of metals, compounds, and gases. A.

537.533.8 : 519.283

STATISTICAL PROBLEMS OF AN ELECTRON MULTIPLIER. See Abstr. 5601

537.533.8

6711. Z DEPENDENCE OF BREMSSTRAHLUNG FOR THE CASE OF COMPLETE SCREENING. K.L.Brown.
Phys. Rev., Vol. 103, No. 1, 243-6 (July 1, 1956).

The relative yield of 235 MeV photons from the elements Cu, Ta and U for incident electrons of energy 500 MeV has been measured by using the photoproduction of positive pions from liquid hydrogen as an essentially monoenergetic photon detector. The observed photon yield per radiation length of uranium relative to copper is 0.878 ± 0.02, and of tantalum relative to copper is 0.937 ± 0.015. These results are consistent with the predictions of a theorem of Olsen which evaluates the integral bremsstrahlung cross-section in terms of the integral pair-production cross-section of Bethe, Maximon and Davies. A.

537.533.8

6712. THE ROLE OF SPIN IN THE STUDY OF THE RADIATING ELECTRON. A.N.Matveev.
Zh. éksper. teor. Fiz., Vol. 29, No. 5(11), 700-1 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 356-7 (March, 1956).

This letter is concerned with the ratio of the magnitude of the radiation from an electron to that from a spinless particle. It is shown that this ratio differs from unity by an amount which is proportional to h^2 and is thus not revealed by treatments which only take account of the first order in h. It is pointed out that a recently published formula by Nelipa (Abstr. 1909/1955) cannot be correct, since it makes the ratio independent of h. P.M.Davidson

537.533.9

6713. EMISSION OF RADIATION BY AN ELECTRON MOVING AT UNIFORM SPEED IN AN ELECTRON PLASMA IN PRESENCE OF A MAGNETIC FIELD. A.A.Kolomenskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 6, 982-5 (1956). In Russian.

Electrons within a plasma (as distinct from single electrons in a dielectric medium) can emit Cherenkov radiation only in presence of a magnetic field. In the present paper conditions are investigated with which Cherenkov radiation must comply. It is found that the frequencies are restricted to two separate bands of which one is lower and the other higher than the Langmuir frequency. Relations are established between frequency and direction of emission and the velocity of the electrons. An expression for the energy spectrum of the emitted radiation is obtained. R.Eisenschitz

PA

537.533.9

6714. RADIOACTIVE ISOTOPE STUDY OF THE DISSOCIATION OF BARIUM OXIDE UNDER ELECTRON BOMBARDMENT. S.Yoshida, N.Shibata, Y.Igarashi and H.Arata.
J. appl. Phys., Vol. 27, No. 5, 497-500 (May, 1956).

The evolution of Ba from BaO was detected by using radioactive Ba^{140}, and the rate was measured for various electron bombardment conditions. The following results were obtained: (1) When the bombarding voltage was fixed, the rate of evolution increased linearly with the number of primary electrons, provided the temperature of the oxide remained constant. (2) The rate of evolution increased exponentially with temperature; the activation energy was about 0.7 eV. (3) The efficiency of 500 eV electrons was far less than of 150 eV electrons at constant bombarding power. (4) The efficiency was around 3.9×10^{-7} atoms per primary electron at 150 eV and 710°K. A simple mechanism of the electron bombardment dissociation is proposed. A.

537.533.9 : 537.534.9

6715. THE DURATION OF A FLASH IN THE VAVILOV–CHERENKOV EFFECT. I.M.Frank.
Uspekhi fiz. Nauk, Vol. 58, No. 1, 111-50 (1956). In Russian.

Paper presented at a Vavilov memorial colloquium. The paper is non-experimental. Topics discussed include flash duration, V.-Ch. effect and luminescence in a non-dispersing medium, V.-Ch. effect in a refracting medium, recorders for V.-Ch. radiation, achromatic recorders. 19 refs.
C.R.S.Manders

537.534

6716. CONSTRUCTION OF A 700 kV ION ACCELERATOR TUBE. DEVELOPMENT OF OSCILLATING ELECTRON ION SOURCES. J.Sommeria-Klein.
Ann. Phys. (Paris), Ser. 13, Vol. 1, 344-94 (March-April, 1956). In French.

A general discussion is given of high-voltage ion accelerators, with particular reference to ion sources and ion optics. An experimental study of the "Heil–von Ardenne" source is reported, and a new arrangement for ion extraction is described. Application of the new extraction method to other types of ion source (e.g. r.f. sources) is discussed. A complete accelerator installation is described briefly.
J.J.Wilkins

537.534

6717. IMPROVING THE CHARACTERISTICS OF THE CYCLOTRON BEAM. W.B.Powell.
Nature (London), Vol. 177, 1045 (June 2, 1956).

The theoretical investigation suggests that by stabilizing the dee voltage to 0.25% and by placing the beam defining slits on the dee interface, a larger and better focused external beam with smaller energy spread can be obtained from the cyclotron. D.R.Chick

537.534

6718. STORAGE-RING SYNCHROTRON: DEVICE FOR HIGH-ENERGY PHYSICS RESEARCH. G.K.O'Neill.
Phys. Rev., Vol. 102, No. 5, 1418-19 (June 1, 1956).

In the scheme proposed, alternate pulses of external beam from an accelerator (e.g. a 3 BeV proton synchrotron) are injected into each of two annular "storage-ring" focusing magnets. The storage-rings contain a common straight section in which the stored beams interact. Tentative design data and strange-particle yields are given for rings storing 3 BeV protons. The proposed mechanism of particle injection into the storage-rings involves the use of energy-loss foils and gas jets. J.J.Wilkins

537.534.3

6719. SMALL GENERAL PURPOSE CYCLOIDAL-FOCUSING MASS SPECTROMETER. C.F.Robinson and L.G.Hall.
Rev. sci. Instrum., Vol. 27, No. 7, 504-8 (July, 1956).

The mass analyser proper, including the magnetic and a high-speed continuous-flow inlet system, weights approximately seventy pounds. The resolving system shows good mass resolving power, sensitivity and analytical accuracy up to about mass 150 a.m.u., and adequate service life. The mass resolving power can be extended substantially in cases where some loss of sensitivity and analytical accuracy is tolerable.

537.534.

6720. NONUNIFORM FIELDS IN CYCLOIDAL-FOCUSING MASS SPECTROMETERS. C.F.Robinson.
Rev. sci. Instrum., Vol. 27, No. 7, 509-12 (July, 1956).

In a cycloidal-focusing mass spectrometer, nonuniformities in the magnetic and electric fields may cause either an actual deterioration of the image quality or merely a shift in the focal point. The latter effect is the more usual one and it can be compensated easily.

537.534.7

6721. MODIFICATION OF THE DOUBLE PROTON SCATTERING EXPERIMENTS. L.N.Rozentsveĭg.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 597-8 (1956). In Russian.

It is proposed that the target be bombarded by molecules of H_2^+, for which the ratio of parahydrogen to orthohydrogen differs markedly from the equilibrium ratio of 1/3. The H_2^+ dissociates immediately and the two protons are scattered independently and analysed in coincidence. This gives P^2 directly, where P is the polarization. G.E.Brow

537.534.7

6722. ELASTIC SCATTERING OF PROTONS BY TRITIUM L.A.Maksimov.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 615 (1956). In Russian.

Phase shifts are determined by fitting experiments in the range of incident proton energies 2.5 to 3.5 MeV. G.E.Brow

537.534.7

6723. STOPPING CROSS SECTION OF SOLIDS FOR PROTONS, 50-600 keV. M.Bader, R.E.Pixley, F.S.Mozer and W.Whaling.
Phys. Rev., Vol. 103, No. 1, 32-8 (July 1, 1956).

The stopping cross-sections of Li, Cu, LiF, CaF_2, Pb and Au for protons have been measured over the energy range E_p = 50-600 keV; the stopping cross-section of Be for protons has been measured for E_p = 50-2600 keV. An electrostatic analyser and magnetic spectrometer were used to measure the energy loss of protons in a thin film of the stopping material. The density of the stopping film was determined by weighing, or by quantitative chemical analysis of, a known area. The ratio of the stopping cross-section of Al, Cu, Mn, Ta and Pb to that of Au was measured by observing the yield of elastically scattered protons from these targets for E_p = 200-600 keV. The ratio of stopping cross-section of Ca, V, Cr, Mn, Fe, Co, Ni, Cu and Zn, to that of Mn was measured for E_p = 200-600 keV by the same method. In the region Z = 23-29, the stopping cross-section decreases as the atomic number of the stopping material increases. The probable error of absolute stopping cross-section measurements in this experiment is 3%. A

DISCHARGE TUBES. COUNTERS 537.54

537.54 : 537.226.

6724. THE CONFIRMATION OF THE BREAKDOWN LAW OF ROGOWSKI AND FUCKS WITH TECHNICAL COLD CATHODE DISCHARGE TUBES. W.Kluge and A.Schulz.
Z. angew. Phys., Vol. 8, No. 7, 328-31 (1956). In German.

An investigation of the lowering of the sparking potential by initial ionization in cylindrical discharge tubes such as photo-cells, glow discharge tubes and relays. C.G.Morga

537.542 : 539.16.08

6725. 4π COUNTERS AND THE ABSOLUTE MEASUREMENT F SMALL SPECIFIC INTENSITIES OF LOW ENERGY RADITION. M:Leistner.
. angew. Phys., Vol. 8, No. 7, 331-7 (1956). In German.
Shows in detail the construction of a 4π counter tube and scusses briefly the circuit arrangements and counter characristics. Comprehensive data for certain absolute measurents of source activity, using UX, are given. J.D.Craggs

537.542 : 539.16.08

6726. NOTE ON INTENSITY MEASUREMENTS WITH IONIZATION CHAMBERS. D.Schulz.
nn. Phys. (Leipzig), Vol. 17, No. 6-8, 423-4 (1956). In erman.
The point at which ionization can be said to be centred within an irradiated chamber is considered and an expression s worked out for its position in the case of small cylindrical nd spherical chambers. D.V.Mabbs

537.542 : 518.5

6727. MEASUREMENT OF FIELD DISTORTION IN FREE-IR IONIZATION CHAMBERS BY ANALOG METHOD. V.Miller and R.J.Kennedy.
. Res. Nat. Bur. Stand., Vol. 55, No. 5, 291-7 (Nov., 1955).
A two dimensional analogue of a free-air ionization chamer for the measurement of field distortion was obtained by ainting conducting lines on resistance paper to represent ross-sections of the electrodes. Guard wires were simulated y driving record player needles into the paper. The volume of he chamber from which charge was collected was related to he resistance between two of the lines on the paper, and small hanges in this volume could be determined accurately by observing resistance changes. Grounded plates external to the hamber were simulated by additional lines painted on the aper, and the effect of these plates on the collecting volume as determined by measuring a change in resistance as the otential of these (simulated) external plates was changed. Measurements were also made for guards in the form of double ires and strips. There is some evidence from measurements n three dimensional ionization chambers that the top and ottom of the surrounding grounded X-ray shield tends to decrease the effects of distortion caused by the ends of the X-ray shield, so that the data obtained here would represent an upper limit to the error for the indicated chamber cross-section. A.

537.542

6728. A HIGH PRESSURE METHANE IONIZATION CHAMBER. F.J.M.Farley.
J. sci. Instrum., Vol. 33, No. 7, 276-8 (July, 1956).
An ionization chamber, 2 in. in diameter and 8 in. long, using quartz-Invar seals is described. Filled with fractionally distilled methane to a pressure of 40 atm and operated at 12 kV the chamber has an efficiency of 10% for counting 3 MeV neutrons and a collection time of the order of 1 μsec. Detailed information on counting efficiencies and delay times is presented. A.

537.542

6729. ON THE MECHANISM OF THE FORMATION OF PULSES IN SEMICONDUCTING CRYSTAL COUNTERS. S.M.Ryvkin.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 2, 250-3 (1956). In Russian.
Extension of some previous work (Abstr. 8296/1954). Proposes an explanation of the observation that in CdS counters the charge collected on the electrodes may exceed that produced by ionization, and also the observation that the size of the pulses increases on illumination of the crystal by light in the photoconductivity band. J.M.Radcliffe

537.542 : 621.374.32

6730. A SIMPLE DIFFERENTIAL PULSE HEIGHT ANALYSER. E.C.Park.
J. sci. Instrum., Vol. 33, No. 7, 257-60 (July, 1956).
A single-channel, pulse height analyser is described. Discrimination is by germanium diodes. Only three valves are used: two double triodes in trigger circuits and another in an anti-coincidence arrangement. The analyser will accept positive pulses of shapes normally encountered with scintillation and proportional counters, and has an accuracy comparable to that of other recently reported circuits. The lower level of the discriminator can be varied from 0-60 V and the channel width from 0-20 V. Bias voltages are read directly on a meter. Zero or threshold adjustments are not required. Both differential and integral output pulses are available. A.

537.542

6731. A "HODOSCOPED" COSMIC-RAY RECORDER. J.C.Barton.
J. sci. Instrum., Vol. 33, No. 8, 308-11 (Aug., 1956).
A portable Geiger-Muller counter apparatus is described. It includes an eight-channel hodoscope and is designed for use at great depths. Simple transistor circuit techniques are used in conjunction with magnetic tape recording. A discussion is given of the operation of counters from a stabilized voltage supply for greatest possible battery life. The complete equipment consumes about 50 mW and will operate unattended from one set of batteries for longer than a month. The apparatus has been operated successfully in a coal mine at a depth of 1500 ft below the surface. A.

537.542

6732. MULTICHANNEL SYSTEMS FOR PULSE-HEIGHT AND TIME-OF-FLIGHT ANALYSIS. H.L.Schultz, G.F.Pieper and L.Rosler.
Rev. sci. Instrum., Vol. 27, No. 7, 437-45 (July, 1956).
Multichannel systems based on the original development of Hutchinson and Scarrott are described. The equipment can be divided into three basic categories: (a) A time channel analyser using serial storage and arithmetic operations. This unit provides approximately 500 2-μsec time channels each having a capacity of 10 binary digits. It is now being used for slow neutron time-of-flight spectroscopy. (b) A pulse-height-to-time converter which when used in conjunction with the above or similar unit forms a multichannel pulse-height analyser with 200 useful channels. (c) Data display systems of two types, one for continuous visual monitoring and one for permanent recording in chart form. A.

537.542

6733. A HIGH-PRESSURE DIFFUSION CLOUD CHAMBER IN A PULSED MAGNETIC FIELD. A.P.Batson, P.N.Cooper and L.Riddiford.
J. sci. Instrum., Vol. 33, No. 8, 302-6 (Aug., 1956).
A description is given of an 18 in. diameter high-pressure diffusion cloud chamber constructed for use with the Birmingham proton synchrotron. The associated equipment to provide a pulsed magnetic field of 13 kG at each synchrotron pulse is discussed and an account of the operation of the apparatus is given. A.

537.542

6734. REMARKS ON THE OPERATION OF THE DIFFUSION CLOUD CHAMBER. II. P.E.Argan, A.Gigli and N.D'Angelo.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1337-59 (June, 1956).
For Pt I, see Abstr. 6246 (1955). A relation is established which has to be satisfied by the parameters characterizing a chamber (nature and pressure of the gas and ion load) if the height of the sensitive layer has to remain unchanged, and a second relation which directly furnishes the height of the sensitive layer as a function of these parameters once it is known for a particular set of them. This relation is discussed in detail and calculated for H_2, D_2, He, CO_2, A and air, for pressures between 0.5 and 20 atm and assuming an ion load, n (num-

ber of ions that are formed per cm^3/sec in the interior of the chamber) between 2 and 100. It is shown how it is possible to calculate in a simple and direct way the temperature gradient, in the zone of the chamber sensitive to the ionizing particles, as a function of its height. The results of the calculation are compared with experimental results. The particular problem considered in Pt I, in which the various parameters were considered to be functions of a horizontal co-ordinate as well as functions of the height measured from the bottom of the chamber (two-dimensional case) are studied in a more general way, keeping still the same geometry of the instrument, the temperatures imposed on the bottom and top, and the organic vapour used. Various temperature and vapour pressure distributions are assumed on the side walls of the chamber (or on plates of any material placed vertically in it) and it is shown how the geometry of the sensitive layer will thereby be changed. Similarly to what was done in the one-dimensional case, one can consider gases of various natures and pressures with different ion loads. The stability conditions of the chamber in varying the ion load are also discussed. The above criteria are applied to the particular case of a chamber operating with methyl alcohol in air at normal pressure. A.

537.542

6735. A LARGE RECTANGULAR WILSON'S (CLOUD) CHAMBER. I.L.Ivanovskaya and A.G.Novikov.
Zh. tekh. Fiz., Vol. 26, No. 1, 209-12 (1956). In Russian.

537.542

6736. HYDROGEN BUBBLE CHAMBER USED FOR LOW-ENERGY MESON SCATTERING. D.E.Nagle, R.H.Hildebrand and R.J.Plano.
Rev. sci. Instrum., Vol. 27, No. 4, 203-7 (April, 1956).

A 2.5 x 2.5 x 10 cm chamber has been developed for experiments on the scattering of particles from the 450 MeV synchrocyclotron. Seventy-five thousand pictures have been taken at the rate of one every two seconds and are being scanned at the rate of two thousand per day. The average track length per picture is ~ 1 g/cm^2. The characteristics of the bubble chamber are described and examples of the pictures are shown. A.

537.543 : 621.385.16.029.6

6737. THEORY OF THE PREOSCILLATING MAGNETRON. I. D.Gabor and G.D.Sims.
J. Electronics, Vol. 1, No. 1, 25-34 (July, 1955).

A rigorous expression for the electron density in an infinitely long cylindrical magnetron is derived for the case of finite emission velocities. The treatment indicates that the limit of the steady state solution as the cathode temperature approaches zero, is a motion of a "double stream" nature. A variational formulation of the Poisson equation clarifies the way in which such a steady state might be built up. G.D.Sims(R)

537.543 : 621.385.16.029.6

6738. COMMENTS ON MAGNETRON THEORY, WITH PARTICULAR REFERENCE TO SOME RECENT PUBLICATIONS. O.Buneman.
J. Electronics, Vol. 1, No. 3, 314-22 (Nov., 1955).

The wartime development of magnetron theory is outlined, beginning with non-existence proofs for double stream steady states, the vindication of the single stream steady state by transient calculations and the recognition that cylindrical symmetry must be abandoned for further progress. The success of work with transverse fields is recalled, giving agreement with experiments in the form of acceptable self-consistent orbits and fields, the threshold criterion and the natural instability of the single stream steady state to travelling wave perturbations, explaining start-up, high noise and high diode currents after "cut-off". Recent publications, all unduly preoccupied with symmetrical steady states, are then discussed, in particular, the papers by Gabor and Sims (see preceding abstract), Twiss (Abstr. 8867/1955) and Mathias (Abstr. 886(1955). Their writers, perhaps unaware of some of the wartime work because of its inaccessibility, draw conclusions which are at variance with the picture developed during the war. However, closer examination shows that their argume and results may be re-interpreted as confirming, rather tha disputing, this picture and, in particular, as vindicating the single stream steady state.

537.543 : 621.385.16.029

6739. THEORY OF THE PREOSCILLATING MAGNETRON D.Gabor and G.D.Sims.
J. Electronics, Vol. 1, No. 4, 449-52 (Jan., 1956).

Reply to Buneman's comments on the authors' work (see the two preceding abstracts).

537.543 : 621.385.16.029.

6740. ON THE PREOSCILLATION STATE IN A CYLINDRICAL MAGNETRON. R.Q.Twiss.
J. Electronics, Vol. 1, No. 4, 454-6 (Jan., 1956).

Reply to Buneman's comments (Abstr. 6738/1956) on the author's work (Abstr. 8867/1955).

IONIZATION. THERMIONICS 537.56/58

537.56

6741. ON THE ANALOGY BETWEEN THE OPERATION O ION SOURCES AND PROBES AT HIGH FREQUENCIES. F.Bertein and A.Pozwolski.
C.R. Acad. Sci. (Paris), Vol. 242, No. 21, 2517-19 (May 23, 1956). In French.

Shows current–voltage characteristics for ion collection by a Faraday cylinder situated below the canal of a discharge run at h.f. in air at 10-60 x 10^{-3} mm Hg pressure. The similarity between these characteristics and those of a Langmuir probe is briefly discussed. J.D.Cragg

537.56

6742. ON THE BEHAVIOUR OF ION COLUMNS IN PURE GASES. A.Müller.
Z. Phys., Vol. 145, No. 4, 469-85 (1956). In German.

Describes measurements of diffusion and recombination in various gases using essentially a pulse method, with α particle ionization. Detailed data are given for the recombination coefficients in oxygen (p = 450 mm Hg) and the diffusion coefficients are given for argon and krypton (p = 600 and 360 mm Hg respectively). J.D.Cragg

537.5(

6743. ELEMENTARY PROCESSES OF ELECTRON RECOMBINATION IN DISCHARGE PLASMAS. E.Schulz-Du Bois
Z. angew. Phys., Vol. 8, No. 6, 267-9 (1956). In German.

A brief analytical review of electron loss mechanisms in afterglows etc., with special reference to l.p. conditions. Diffusion (principally ambipolar), recombination and attachment processes are discussed. J.D.Cragg

537.56

6744. THE FIRST TOWNSEND IONIZATION COEFFICIEN FOR HYDROGEN. D.J.Rose, D.J.De Bitetto and L.H.Fisher
Nature (London), Vol. 177, 945-6 (May 19, 1956).

Gives experimental results for α/p_0 (α the ionization coeff., p_0 the gas pressure at 0°C) for a range of p_0/E (E the electric field strength) from about 0.001 to about 0.065 mm Hg cm/volts. The results obtained by Rose were for pressures in the range 0.5 to 45 mm Hg, and those by Bitetto and Fishe for pressures of 100 and 200 mm Hg. Comparison is made with the results of previous investigations. J.Dutto

537.564 : 541.124.7

745. DISSOCIATION OF POSITIVE IONS IN COLLISIONS ITH MOLECULES. S.E.Kupriyanov, M.V.Tikhomirov and .K.Potapov.
h. éksper. teor. Fiz., Vol. 30, No. 3, 569-70 (1956). In ussian.

Dissociation of CO^+, CO_2^+, CH^+ and CH_2^+ in collision with arious gases is studied at ion energies of 2500 eV.

G.E.Brown

537.564 : 537.534

746. FORMATION OF NEGATIVE HYDROGEN IONS IN OLLISIONS OF PROTONS WITH GAS MOLECULES. a.M.Fogel' and R.V.Mitin.
h. éksper. teor. Fiz., Vol. 30, No. 3, 450-7 (1956). In ussian.

The effective cross-sections for capture of two electrons y protons colliding with gas molecules of H_2, N_2, O_2, He, e, and A were measured in the energy range from 9.5 to 9 keV. The energy dependence of the ratio between the umber of negative hydrogen ions and the number of protons n an equilibrium beam formed after the passage of the roton beam through gaseous targets of each of the mentioned ases was also determined. The data obtained have been used o calculate cross-section for capture of a single electron in ollisions between a fast hydrogen atom and hydrogen mole- ule. A.

537.568

747. RECENT LABORATORY STUDIES OF RECOMBIN- TION CROSS-SECTIONS. J.Sayers.
olar eclipses and the ionosphere (London) 212-14. See Abstr. 116 (1956).

A special tube has been developed which, in addition to neasuring the rate of disappearance of ions or electrons in an fterglow following ionization, incorporates an r.f. mass pectrograph which identifies the ions at the same time. Pro- isional results of rate coefficients are given for oxygen and itrogen for electron temperatures of a few thousand degrees.

G.M.Brown

537.568 : 535.33

748. PROCESS OF DISAPPEARANCE OF ELECTRONS URING THE PHOSPHORESCENCE IN ARGON. C.Joslet, .Weniger and R.Herman.
.R. Acad. Sci. (Paris), Vol. 242, No. 21, 2538-9 (May 23, 956). In French.

Very variable recombination constants are found accord- ng to the method of excitation. Emission spectra were photo- raphed from a condensed discharge between Cu electrodes in rgon containing water vapour. From the variation in time f the H line profiles it was shown that the recombination is ue to the capture of electrons by H^+ ions. At the end of the hosphorescence process Cu lines are emitted following lectron capture by Cu^+ ions. Other experiments were made n O_2 and H_2. No abnormal recombination coefficients were bserved. S.T.Henderson

537.58 : 537.533.2

THERMIONIC EMISSION, FIELD EMISSION, AND THE RANSMISSION REGION. See Abstr. 5915

537.583 : 621.385.032.216

749. EQUIVALENT CIRCUIT FOR THE OXIDE-COATED ATHODE. R.E.J.King.
. appl. Phys., Vol. 27, No. 3, 308-9 (March, 1956).

Tomlinson's circuit (Abstr. 7529/1954) is retained, but ith a different interpretation. The "knee" of the I-V curves s caused by saturation of the pores and the series grain- esistance may become greater than the pore resistance, so at the temperature coefficient of the grain resistance finally ecomes dominant in the temp. dependence of the conductivity. he model is further amplified. A.H.W.Beck

COSMIC RAYS 537.591

537.591.1

6750. THE SPECTRA OF PROTONS AND π^--MESONS AT SEA-LEVEL. L.I.Potapov and N.V.Shostakovich.
Dokl. Akad. Nauk SSSR., Vol. 106, No. 4, 641-4 (1956). In Russian.

The authors employed an Alikhanyan–Alikhanov magnetic spectrometer making measurements with three variations in the numbers and arrangements of the counters below the poles of the magnet. The readings taken over a period of 2220 hours give, for intervals in the range 0.5 to $>5 \times 10^8$ eV/c, the numbers of positive and negative particles, the numbers of protons, energies, and intensities of the vertical proton current. The curve of the latter plotted against momentum is practically straight for momentum in excess of 1.0 BeV/c whilst for smaller momenta the slope tails off to zero. These results correspond closely with those found by Mylroi and Wilson (Abstr. 5518/1951) who used a similar method,and an expression is given for this slope. The data for negative particles were not sufficient to establish the form of the π^--meson spectrum. Results obtained by several workers at a height of 3200 metres show the same general form as those obtained at sea-level. C.R.S.Manders

537.591.1

6751. INTERGALACTIC SPACE AND COSMIC RAYS. G.Cocconi.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1433-42 (June, 1956).

Arguments are presented suggesting that the most energetic particles observed in the cosmic radiation are accelerated outside the galaxy, in the intergalactic space. The problem of the cosmic-ray acceleration in the intergalactic space is discussed and some possible models are presented. A.

537.591.1 : 523.75

6752. OBSERVATIONS OF COSMIC RADIATION FOLLOWING THE SOLAR FLARE OF FEBRUARY 23RD, 1956. H.Trefall and B.Trumpy.
Physica, Vol. 22, No. 7, 579-83 (July, 1956).

A summary of measurements of cosmic radiation on February 23rd, 1956, performed in Bergen, Norway, is presented. Altogether 7 different components were studied. During the first 16 minutes of the event (03.44-04.00 GMT) the soft and hard intensities lay 350% and 89%, respectively, above their normal values. The data indicate that the extra radiation from the sun had a greater proportion of particles with high energies during the peak of the event than later on. A.

537.591.1

6753. THE HODOSCOPE DELAYED-COINCIDENCE METHOD AND ITS APPLICATION FOR THE INVESTIGATION OF SLOW-MESON FORMATION IN COSMIC RAYS. I. EXPERIMENTAL METHOD. G.B.Zhdanov.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 437-49 (1956). In Russian.

The usefulness of the hodoscope delayed-coincidence method for the investigation of the elementary processes of generation of slow π^+-mesons by the nuclear-active component of the cosmic radiation is demonstrated. Description of the apparatus and an analysis of the various apparatus effects is presented. The effective energy of the generating particles is estimated. Corrections which must be taken into account when determining the energy spectrum and the absolute intensity of generation of π^+-mesons are also considered. A.

537.591.1

6754. MESON CREATION IN Pb, Cu AND C NUCLEI BY COSMIC RAYS IN THE STRATOSPHERE. D.Kaipov and Zh. Takibaev.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 471-6 (1956). In Russian.

The cross-section for meson creation in various nuclei was investigated. It was found that the energy dependence of the meson creation cross-section is different at high and low energies. A.

537.591.15

6755. OBSERVATIONS ON ELECTROMAGNETIC CASCADES IN NUCLEAR EMULSIONS. K.Pinkau.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1285-315 (June, 1956).

Four cascades, each initiated by a single photon, have been studied in detail. Target diagrams are made at different depths and the energy of every particle plotted has been determined by multiple scattering measurements. The results are compared with shower theory for lateral and longitudinal development under approximation A of Rossi and Greisen. The theory is found to give a consistent picture within the fluctuation possibilities up to a primary energy of 10^6 MeV. The distribution of particles very near the core is consistent with a law like r^{s-2}. Comparison is made with the calculations of the root mean square lateral displacement by Chartres and Messel. A.

537.591.15

6756. ENERGY SPECTRUM OF THE PENETRATING PARTICLES IN EXTENSIVE ATMOSPHERIC COSMIC RAY SHOWERS. I.I.Sakvarelidze.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 458-63 (1956). In Russian.

The depth-intensity curve for the penetrating shower particles absorbed in lead or in rock was measured at an altitude of 400 m above the sea level and at depths of 3.7, 5.9, 27, 65.5 and 148 m of water equivalent. The integral energy spectrum found from the curve has the form $E^{-\gamma}$ where $\gamma = 0.62 \pm 0.05$ (in the energy range between 5×10^8 and 3×10^{10} eV). A.

537.591.5

6757. A STUDY OF THE NUCLEONIC COMPONENT OF THE COSMIC RADIATION IN THE VICINITY OF THE EQUATOR BY MEANS OF SENSITIVE EMULSIONS. Tsai-Chü.
Ann. Phys. (Paris), Sér. 13, Vol. 1, 291-343 (March-April, 1956). In French.

A thesis. Methods for obtaining the distribution with zenith angle and the vertical intensity of the nucleonic component are discussed. The variation with energy, the east–west asymmetry and the absolute vertical intensity and the effect of latitude have been determined. The emulsions used were exposed at Costermansville in the Belgian Congo, altitude 1600 m and at Tamanrasset, Algeria at a height of 1405 m. 53 refs.
D.J.Prowse

537.591.5 : 523.72

6758. LOW-ENERGY PRIMARY COSMIC-RAY PARTICLES IN 1954. H.V.Neher.
Phys. Rev., Vol. 103, No. 1, 228-36 (July 1, 1956).

The experiments herein described support and extend the relationship found by Forbush, namely, that there is an inverse relationship between solar activity and cosmic-ray intensity. During the summer of 1954 the sun was at a minimum of activity. Ionization chambers set up in the Arctic as well as at intermediate latitudes showed a considerable increase in intensity, during the period, compared with 1951. Atmospheric absorption combined with magnetic rigidity requirements indicate that protons with energies down to at least 150 MeV were coming to the earth in the summer of 1954. It is concluded that there was no cutoff of primary particles, i.e., no "knee", at least for protons down to this energy. Using the increased areas under the ionization-depth curves, combined with geomagnetic claculations, an estimate may be made of the numbers of primary particles coming in near the poles in 1937 (solar maximum), 1951 and 1954 (solar minimum). These values are 0.10, 0.14 and 0.24 $cm^{-2}.sec^{-1}.sterad^{-1}$, respectively. The fluctuations in 1954 were also small compared with those measured in 1937, 1938 and 1951. The evidence points to low intensity and large fluctuations of cosmic rays when the sun is active and vice versa. These changes may be understood qualitatively by assuming a modulating mechanism in the form of clouds ejected from the sun and varying with the solar cyc

537.591.5 : 523.74

6759. COSMIC-RAY NEUTRON INTENSITY INCREASE ASSOCIATED WITH SOLAR FLARE OF FEBRUARY 23, 1956.
J.A.Lockwood, H.E.Yingst, A.R.Calawa and G.Sarmaniote.
Phys. Rev., Vol. 103, No. 1, 247-8 (July 1, 1956).

An increase of 35-fold in the cosmic-ray intensity was observed with a neutron detector located at Durham, New Hampshire (geomagnetic latitude $\lambda = 54^\circ$ N), during the solar flare which began at 0330 UT, February 23, 1956. For several days prior to the onset of the flare a large decrease in the daily average neutron intensity was recorded.

537.591.5 : 523.7

6760. EXTRAORDINARY INCREASE OF THE COSMIC RADIATION ON FEBRUARY 23, 1956. R.B.Brode and A.Goodwin, Jr.
Phys. Rev., Vol. 103, No. 2, 377 (July 15, 1956).

During the solar flare event of February 23, 1956, the nucleonic intensity increased by an estimated 600% above normal. The ionizing intensities measured with a shielded (20 cm Pb) and an unshielded Geiger counter telescope showe an estimated increase of 38% and 58% above normal at Berkeley. The time of onset occurred in the interval 0345-0400 UT.

537.591.

6761. POSITIVE TEMPERATURE EFFECT OF COSMIC RAYS. S.Hayakawa, K.Ito and Y.Terashima.
Progr. theor. Phys., Vol. 14, No. 6, 497-510 (Dec., 1955).

The temperature effect on the intensity of μ-mesons at sea-level is investigated by taking the π-μ decays into accoun The positive temperature coefficient is calculated by paying special attention to the difference in the attenuation mean free path of the N-component and the absorption mean free path of π-mesons and to the atmospheric depth which are the main co tributions to the coefficient. The magnitude of the coefficient is obtained as $0.05\%/^\circ$C and the depth of main contributions is found to be 200 mb. Influence of the heavy mesons is discuss qualitatively.

MAGNETISM 538

53

6762. SUMMARIZED PROCEEDINGS OF A SYMPOSIUM O MAGNETISM — LONDON, SEPTEMBER, 1955. A.C.Lynch and J.Watkins.
Brit. J. appl. Phys., Vol. 7, No. 7, 236-42 (July, 1956).

An informal symposium on recent developments in magnetism held by the Electronics Group of The Institute of Phys The subjects discussed ranged from some latest advances in theoretical studies, to the application of magnetic materials t computor systems.

538.082 : 621.317.43

6763. AN INSTRUMENT FOR THE AUTOMATIC RECORDING OF HYSTERESIS LOOPS. D.C.Gall and J.D.Watson.
J. sci. Instrum., Vol. 33, No. 7, 265-8 (July, 1956).

The cycle of magnetization is carried out in about fifteen minutes. The induction in the specimen is measured by electro-mechanical integration of the induced electromotive force in a search coil, by a miniature electric motor having accurate proportionality between speed of rotation and applie

oltage. The apparatus so far has been applied only to ring pecimens in which the value of magnetizing force is directly ependent on the magnetizing current. The magnetizing force, the case of the ring specimens used, is measured in terms the voltage drop across a shunt carrying the magnetizing urrent. Novel features of the design are the method of inte-rating the search coil voltage, and the incorporation of auto-natic control of the magnetizing current, with the object of naintaining the search coil electromotive force within the ange of the integrator motor at all times. A.

538.113

764. THE KINETICS OF PARAMAGNETIC PHENOMENA. .P.Silin.
h. éksper. teor. Fiz., Vol. 30, No. 2, 421-2 (1956). In ussian.

The paper refers to the inadequacy arising in a kinetic heory of the electrons in a metal when limited to a distribu-on function giving the number of electrons in a cell of phase pace. A new equation is set out in which a vector magnetiz-tion density in phase space is introduced. Results are de-ived from it corresponding to those of Dyson (Abstr. 6335/955) and Bloch (Abstr. 407/1947). C.R.S.Manders

538.114

765. ON INDIRECT EXCHANGE INTERACTION. .V.Vonkovskiĭ and Yu.M.Seĭidov.
okl. Akad. Nauk. SSSR, Vol. 107, No. 1, 37-40 (1956). In ussian.

The term "indirect exchange" refers to the simultaneous nteraction of a diamagnetic atom with two adjacent paramag-etic atoms; in a simplified theory the phenomenon can be pecified by the interaction of a pair of p-electrons in an atom vith single s-electrons in two adjacent atoms. In this paper a nethod is developed for deriving the contribution of indirect xchange to the energy of a ferromagnetic or antiferromagne-ic ionic crystal; it is a perturbation method in which the cor-elations between different electrons are taken into account nd the overlap of neighbouring atoms is assumed to be small. t is found that the indirect exchange is a fourth order effect nd that indirect and ordinary exchange energies have equal ign. Assumptions usually made in the theory of antiferro-magnetism are found to be in accordance with the results ob-ained. R.Eisenschitz

538.114 : 539.234

6766. REMARKS ON THE THEORY OF THE MAGNETIC PROPERTIES OF THIN LAYERS AND FINE GRAINS. L.Néel.
J. Phys. Radium, Vol. 17, No. 3, 250-5 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

The author shows, first, that in the case of powdered iron, the variation of the coercitive field against the grain size, is correctly interpreted by supposing that the energy spent during a hysteresis cycle is only used for the irreversible pro-duction of the system of "walls" (produced twice in a cycle in the region where the resulting magnetization nears zero). Agreement with theory is already less good for magnetite and becomes very bad for Mn–Bi : for the latter, and generally for the substances with only one direction of easy magnetiza-tion, the coercitive field is rather determined by the difficul-ties in forming the nuclei of inversion of the magnetization. No satisfactory theory is now available for these phenomena of "nucleation" : serious theoretical objections can be raised in fact against the theory proposed by Kittel. In the second part, the author deals again with the theory of the coercitive field of thin continuous layers, and shows that the superficial energy of Bloch's "walls" has no constant value but increases as soon as the thickness of the wall is not negligible when com-pared with the thickness of the layer: let 0.1 μ be the thickness of an iron layer, the "wall" energy is 7 erg/cm^2, the normal value being 1.4 erg/cm^2. It is perhaps an explanation of the increase of the coercitive field of thin layers when their thick-ness decreases. A.

538.114

6767. THEORETICAL STUDY ON THE ANTIFERROMAG-NETIC ROTATOR WITH RHOMBIC SYMMETRY.
H.J.Gerritsen and M.Garber.
Physica, Vol. 22, No. 6, 481-502 (June, 1956).

A theoretical analysis is given of the intensity of the anti-ferromagnetic resonance absorption. The theory is based on the molecular field model of antiferromagnetism. A small oscillating magnetic field, $h\exp(i\omega t)$, and damping terms are introduced in the equations of motion. It is then possible to define a high frequency antiferromagnetic susceptibility and to calculate the absorption intensity as $A = \frac{1}{2}h^2\omega\chi''$. Calculations have been carried out for the absorption intensity in $CuCl_2.2H_2O$ as a function of the relative orientation of the static external field, the high frequency field and the crystal axes, and as a function of temperature. Reasonably good quantitative agree-ment is found between the detailed measurements described in an earlier paper (Abstr. 4500/1956) and the calculations. A.

538.114

6768. ON HIGH TEMPERATURE EXPANSIONS IN THE HEISENBERG THEORY OF FERROMAGNETISM. C.Domb and M.F.Sykes.
Proc. Phys. Soc. B, Vol. 69, Pt 4, 486 (April, 1956).

Describes a method of calculation of the high-temperature susceptibility in series form, in which averages of the permu-tation operators rather than of spin operators are computed, and obtains the final results more simply than in Abstr. 2224 (1956). An additional expansion coefficient, a_6, is calculated for a number of lattices. E.P.Wohlfarth

538.114

6769. NOTE ON THE SPIN WAVE THEORY OF ANTI-FERROMAGNETISM. J.Kanamori and K.Yosida.
Progr. theor. Phys., Vol. 14, No. 5, 423-34 (Nov., 1955).

Spins in an antiferromagnet subjected to an external field perpendicular to the preferred axis of antiferromagnetic magnetization are not exactly aligned parallel and antiparallel to this axis. It is shown that a better approximation to the spin wave theory can be worked out, if one takes the equilibrium directions of the spins as the axes of quantization. One obtains field-dependent resonance frequency of a microwave, which the usual spin wave theory fails to give, and also a higher approximation to the perpendicular susceptibility. The value of the latter in the limit of vanishing field strength agrees with that obtained by Kubo. A.

538.22 : 539.27

6770. ELECTRON OPTICAL METHOD OF STUDYING DYN-AMIC THERMAL PROCESSES IN OPAQUE MEDIA.
G.V.Spivak and T.N.Dombrovskaya.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 1, 39-41 (1956). In Russian.

A ferro- or paramagnetic specimen is used as a second-ary emitting cathode in the field of a magnetic lens. As the temperature of the cathode is raised through the Curie point a "temperature wave" is seen to travel across the secondary emission image due to the local influence of changing mag-netic field associated with the magnetic transformation of the specimen. J.W.Menter

538.22

6771. THE MAGNETIC PROPERTIES OF CHROMIUM-TELLURIUM-SELENIUM SYSTEM. I.Tsubokawa.
J. Phys. Soc. Japan, Vol. 11, No. 6, 662-5 (June, 1956).

The change of magnetic properties due to the replacement of tellurium by selenium in CrTe, which has NiAs structure, was investigated. Ferromagnetism is observed in the concen-tration range from $x = 0$ to $x = 0.8$, where x is defined by $Cr(Te_{1-x}Se_x)$. The compounds outside this range are para- or antiferromagnetic. In the paramagnetic range of temperature the Curie–Weiss law is found to be valid. It was also found that the Curie–Weiss constant is independent of concentration in the neighbourhood of CrTe and CrSe respectively, and

varies abruptly at the transition concentration from ferro- to antiferromagnetic state. A.

538.22

6772. THE MAGNETIC PROPERTIES OF $FeSe_x$ WITH THE NiAs STRUCTURE. T.Hirone and S.Chiba.
J. Phys. Soc. Japan, Vol. 11, No. 6, 666-70 (June, 1956).

The thermal and X-ray analyses were carried out for iron-selenium system from 48.8 to 57.4 atomic percent of selenium, such range being previously reported to be ferrimagnetic. It was concluded from the experimental results that at room temperature the concentration range from 48.8 to 53.1% selenium is the two phase region $\alpha + \beta$; α has the PbO type structure and β the NiAs type. These two phases transform through a eutectoid reaction into a γ phase with the NiAs structure of slightly different lattice parameters in comparison with those of the β phase, the eutectic temperature being 350° C. The solubility limit in iron side of the phase lies at 53.1% selenium. It is remarkable that the substance with stoichiometric concentration (50% Se) does not lie in the single phase region of NiAs type. It was also found that the ferrimagnetism of this binary system originates from the phase of NiAs type (β phase) and the α phase is weakly paramagnetic or antiferromagnetic. The Curie point of the compound containing 53.1% selenium is 174° C and the spontaneous magnetization at absolute zero of temperature is 0.20 Bohr magneton. This magnitude of magnetization is explained by assuming a kind of the ordered arrangement of ferric ion in the crystal lattice. A.

538.221

6773. INITIAL PERMEABILITY AND GRAIN SIZE OF MANGANESE-ZINC FERRITES. C.Guillaud and M.Paulus.
C.R. Acad. Sci. (Paris), Vol. 242, No. 21, 2525-8 (May 23, 1956). In French.

The initial permeability was found to increase from about 500 to about 3700 as the average grain size increases from about 2μ to 20μ. The results are discussed by considering the combined effects of rotational and translational magnetization processes. E.P.Wohlfarth

538.221

6774. MECHANISM BY WHICH COBALT FERRITE HEAT TREATS IN A MAGNETIC FIELD. H.J.Williams, R.D.Heidenreich and E.A.Nesbitt.
J. appl. Phys., Vol. 27, No. 1, 85-9 (Jan., 1956).

Magnetic torque measurements and electron diffraction patterns on several cobalt ferrite and cobalt-zinc ferrite crystals show that those compositions which respond to heat treatment in a magnetic field contain precipitated particles of a second phase. Response of these crystals to heat treatment in a magnetic field is apparently due to the tendency of the precipitated particles to grow preferentially along the field direction in a manner similar to that previously reported by Heidenreich and Nesbitt for Alnico 5. When the crystals are heat treated without a magnetic field the precipitated particles are oriented along the crystal axes, and the shape anisotropy of the particles arrayed in this manner causes a reversal in sign of the torque as the measuring field is increased from zero. This anomalous variation of the torque with field was previously observed with Fe_2NiAl and explained on the same basis. Thus a single mechanism explains the aforementioned magnetic phenomena observed in Fe_2NiAl, Alnico 5, and the cobalt ferrites. A.

538.221

6775. TEMPERATURE BEHAVIOR OF FERRIMAGNETIC RESONANCE IN FERRITES LOCATED IN WAVE GUIDE. B.J.Duncan and L.Swern.
J. appl. Phys., Vol. 27, No. 3, 209-15 (March, 1956).

Ferrimagnetic resonance has been investigated in several polycrystalline ferrites located in wave guide over a temperature range from 25° C to the Curie point of each ferrite. The ferrimagnetic resonance line width and the apparent gyromagnetic ratio of two types of ferrites were found to change with increasing temperature. The theories of Wangsness and Kittel have been utilized in interpreting the observed effects. The foregoing effects were shown to influence the temperature behaviour of the microwave properties of ferrites away from resonance. A

538.221 : 537.31

6776. NICKEL COPPER FERRITES FOR MICROWAVE APPLICATIONS. L.G.Van Uitert.
J. appl. Phys., Vol. 27, No. 7, 723-7 (July, 1956).

Ferrites having both high relative density (~98%) and high d.c. resistivity ($> 10^9$ ohm.cm) can be prepared by properly sintering nickel copper ferrites which have both an iron deficiency and a small amount of manganese or cobalt present. Magnetic saturation at room temperature shows a linear dependence upon copper content in this system varying from 3150 gauss for $NiFe_{1.9}Mn_{0.02}O_{4\pm}$ to 2400 gauss for furnace cooled $CuFe_{1.9}Mn_{0.02}O_{4\pm}$. Direct current resistivity remains high for mixtures of these two ferrites if 2Cu < Ni. An anomalous break in the curve relating d.c. resistivity with copper content occurs when the copper to nickel ratio exceeds this 1 : 2 value. A

538.221 : 539.23

6777. RÉSUMÉ OF THE PRINCIPAL WORK ON THE MAGNETIC PROPERTIES OF THIN METALLIC LAYERS. A.Colombani.
J. Phys. Radium, Vol. 17, No. 3, 263-9 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

Influence of temperature and structure of the deposit on the production of ferromagnetism in thin metallic layers is considered, together with the fact that, for very thin layers, the coercitive field of the deposit can reach a value greater than that of the solid metal. This second fact has originated many researches on the ferromagnetic alloys for example. Both theory and experimental results show that, if the temperature is low enough, even a mono-atomic layer should be ferromagnetic. These three important facts have only been established after much research, of which the most important results were: Maurain's, the first to be reproducible, and showing the existence of rectangular cycles and the phenomen of remote magnetization; the author's, showing the influence of temperature and structure on the production of ferromagnetism; and those of Crittenden. The last seem to agree with the Klein and Smith theory, issued from the Bloch method, though valid only for very low temperatures. A

538.221 : 539.23

6778. FERROMAGNETIC PROPERTIES OF THIN NICKEL FILMS. E.C.Crittenden, Jr and R.W.Hoffman.
J. Phys. Radium, Vol. 17, No. 3, 270-3 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

The ferromagnetic properties of thin films of nickel in th thickness range 20 A to 495 A are reported as a function of temperature between 4° K and 475° K. The behaviour of the hysteresis loops is consistent with Kittel's theory. The data on saturation magnetization as a function of temperature is as yet not able to settle the question of the slope at T = 0, althou better data is anticipated soon. The theory of Klein and Smit fits the observations of Curie temperature as a function of thickness surprisingly well. A

538.22

6779. NOTE ON AN INVESTIGATION OF THE ANOMALOU TIME-CONSTANT OF CERTAIN IRON DEFICIENT MAGNESIUM MANGANESE FERRITES. L.C.F.Blackman and N.P.R.Sherry.
J. Electronics, Vol. 1, No. 4, 385-8 (Jan., 1956).

An investigation of the effect of fabrication conditions on the properties of certain iron-deficient magnesium manganese ferrites revealed that the time constant (t = RC) of the materia

as remarkably dependent on the firing temperature. A starting anomalous peak of time-constant occurred when the samples were fired within the very narrow temperature range from 1330 to 1380°C. It was found that although both the resistive and dielectric components of the time-constant exhibited a peak at the critical region, the latter was by far the more pronounced A.

538.221

780. SATURATION MOMENTS AND d-BAND CONFIGURATIONS IN IRON AND ITS ALLOYS. B.R.Coles and W.R.Bitler.
Phil. Mag. (Ser. 8), Vol. 1, No. 5, 477-86 (May, 1956).

The saturation magnetic moments of certain iron alloys are difficult to interpret in terms of models found satisfactory for nickel alloys. It has been suggested that in pure iron the total number of empty d-band states is appreciably greater than the number of unpaired spins calculated from the saturation moment. The saturation moments of some iron—cobalt—aluminium alloys have therefore been measured and the effect of aluminium on the moments of iron—cobalt alloys is compared with its effect on the moment of pure iron. It is concluded that in iron the number of empty d-states exceeds the number of unpaired spins; the latter quantity is 2.22 per atom, while the value suggested for the former is greater than 3 per atom. The details of the effects found in the ternary alloys are discussed in terms of the d-band shape. A.

538.221

781. SPIN EXCHANGE EFFECTS IN FERROMAGNETIC RESONANCE. J.R.Macdonald.
Phys. Rev., Vol. 103, No. 2, 280-6 (July 15, 1956).

A discussion of theoretical and experimental work concerned with spin exchange effects in ferromagnetic resonance is given. Qualitative and quantitative results of the author's exchange theory are summarized together with work of Ament and Rado in the same field. An approximate solution of the exchange problem due to the latter authors is used to analyse the recent ferromagnetic resonance results of Hoskins and Wiener on permalloys. Such analysis indicates that some of the observed effects may have arisen from exchange but that it cannot explain the observed experimental g shifts from the free-spin value. A.

538.222/.224

6782. ON DIA- AND PARAMAGNETISM IN METALLIC MIXED CRYSTAL SERIES. VII. α-PHASES OF COPPER AND SILVER WITH B-ELEMENTS. E.Vogt and H.Friedewold.
Ann. Phys. (Leipzig), Vol. 17, No. 6-8, 281-92 (1956). In German.

New measurements of the susceptibility of Cu—Al, Ag—Tl, and Ag—Pb alloys are described and considered, together with older results, in relation to the predictions of Friedels's theoretical treatment of alloys of the noble metals with elements of the B sub-groups. The measurements are in good agreement with the prediction that in these alloys the elements of the B sub-groups are present in a singly, or at most doubly, ionized state. A.E.De Barr

538.222

6783. SPECTROMETER FOR PARAMAGNETIC RESONANCE. STUDY OF FREE RADICALS IN IRRADIATED (γ-RAY) SUBSTANCES AND IN COALS. J.Uebersfeld.
Ann. Phys. (Paris), Ser. 13, Vol. 1, 395-461 (March-April, 1956). In French.

An account of a paramagnetic resonance spectrometer with a discussion of design details and sensitivity. Also a fuller account of the results on γ-irradiated glasses, polymers, amino acids, sugars and coals already briefly reported. D.H.Whiffen

538.222 : 539.152.1

6784. FINE AND HYPERFINE STRUCTURE OF THE PARAMAGNETIC RESONANCE OF DIVALENT EUROPIUM. A.A.Manenkov and A.M.Prokhorov.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 3, 402-4 (1956). In Russian.

In the electron resonance spectrum of Eu^{++} in SrS there are 12 hyperfine lines in the $M = 1/2$ to $-1/2$ transition and the spins of Eu^{151} and Eu^{153} are both 5/2. The Hamiltonian coefficients are $A_{151} = (30.0 \pm 0.1)$ and $A_{153} = (13.4 \pm 0.1) \times 10^{-4}$ cm^{-1}, $g = 1.992 \pm 0.001$ and the ratio $\mu_{151}/\mu_{153} = 2.24 \pm 0.03$. For a single crystal with Eu^{++} in CaF_2 $A_{151} = (34.67 \pm 0.1)$, $A_{153} = (15.41 \pm 0.1) \times 10^{-4}$ cm^{-1}, $g = 1.971 \pm 0.001$ and $\mu_{151}/\mu_{153} = 2.25 \pm 0.03$. D.H.Whiffen

538.222 : 539.132

6785. NOTE ON THE ELECTRON SPIN RESONANCE OF THE V_1-CENTER. T.Inui, S.Harasawa and Y.Obata.
J. Phys. Soc. Japan, Vol. 11, No. 5, 612 (May, 1956).

The g value for Cl_2^- is calculated on a L.C.A.O. molecular orbital approximation and agrees with that observed for a V_1 centre (Abstr. 1390/1956). D.H.Whiffen

538.24

6786. DEMAGNETIZATION OF MAGNETS DUE TO CONTACT WITH FERROMAGNETIC BODIES. M.McCaig.
J. sci. Instrum., Vol. 33, No. 8, 311-12 (Aug., 1956).

The circumstances in which permanent magnets are partially demagnetized by repeated contacts with ferromagnetic bodies have been investigated. If a bar magnet is placed a few times on a block of mild steel and removed by a sliding motion parallel to its length, a loss of magnetization of the order 40% may occur. Over 3 mm thickness of protective material is necessary to keep the losses below 1%. A.

538.24 : 548

6787. MAGNETIZATION CURVES AND DOMAIN STRUCTURE. L.F.Bates and A.Hart.
Proc. Phys. Soc. B, Vol. 69, Pt 5, 497-505 (May, 1956).

For the two main faces of a Néel-cut crystal of silicon iron a detailed study is made of the changes in domain patterns occurring when the crystal dimensions are changed. The contribution of closure domain systems to bulk magnetization along a [110] direction is treated experimentally and theoretically; the results explain differences between the ideal (Akulov) magnetization curve and curves obtained experimentally, and prove that a substantial hysteresis loss occurs in high fields with crystals of finite size. A.

538.24

6788. THE EFFECT OF THE METHOD OF DEMAGNETIZATION OF THE SPECIMEN ON THE TEMPERATURE DEPENDENCE OF THE MAGNETIZATION OF NICKEL IN WEAK FIELDS. A.I.Drokin and V.L.Il'yushenko.
Zh. éksper. teor. Fiz., Vol. 29, No. 3 (9), 339-44 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 191-6 (March, 1956).

By two different methods, a study was made of the effect of the method of demagnetization of the specimen on the temperature variation of the intensity of magnetization of nickel in weak magnetic fields. A.

538.244.2 : 537.311.33 : 539.172

6789. PRODUCTION AND USE OF HIGH TRANSIENT MAGNETIC FIELDS. I. H.P.Furth and R.W.Waniek.
Rev. sci. Instrum., Vol. 27, No. 4, 195-203 (April, 1956).

Experiments involving pulsed magnetic fields of a half-megagauss and more are shown to be practical. Some basic concepts are developed regarding the construction of impact resistant solenoids and the selection of the appropriate power supply. Operation of various high-field magnets in the pulse range 50 to 10 000 μsec is discussed, and some techniques for associated solid state experiments are given. Magnetoresistance measurements up to 600 000 gauss have been made for germanium. Operation of a 175 000 gauss Helmholtz-type magnet for nuclear track plate work with the 95 MeV Harvard synchrocyclotron is described. A.

ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3 : 532.5

6790. AXISYMMETRIC MAGNETIC FIELDS AND FLUID MOTIONS. S.Chandrasekhar.
Astrophys. J., Vol. 124, No. 1, 232-43 (July, 1956).

The equations of hydromagnetics appropriate for an incompressible inviscid fluid of finite electrical conductivity are considered in cases in which the magnetic fields and the fluid motions have symmetry about an axis. By using a known theorem that a solenoidal vector field can be expressed as a superposition of a poloidal and a toroidal field, the equations are reduced to four equations for four governing scalars. In the limiting case of infinite electrical conductivity, a general relation is derived which includes, as special cases, the known theorems on force-free fields, isorotation, and conditions for hydrostatic equilibrium. Some integral relations which follow from the four equations are also derived. A.

538.3 : 532.5

6791. ON THE EFFECT OF FLUID MOTION ON THE INITIAL DECAY OF A MAGNETIC FIELD IN A SPHERE. S.C.Pao.
Astrophys. J., Vol. 124, No. 1, 266-71 (July, 1956).

Selection rules are derived which govern the interaction between the various axisymmetric modes of velocity and magnetic fields in a fluid conductor. These selection rules determine the initial rate of decay of a magnetic field. A.

538.3 : 530.12

6792. ON THE ELECTRODYNAMICS OF MOVING BODIES BASED ON THE METRIC OF FOUR-SPACE. S.C.Kar.
Bull. Calcutta Math. Soc., Vol. 47, No. 3, 171-89 (Sept., 1955). In German.

In the rest frame of a homogeneous isotropic body, the 4-spaces within and around the body are assumed to be conformal to flat spaces in which the velocity of light is respectively c/n and c. The field equations in a uniformly moving body are expressed as tensor equations relative to the appropriate 4-space and involve a Lorentz invariant scalar $\eta = \epsilon/n = n/\mu$. The new theory is compared with the Minkowski formulation. R.A.Newing

538.3 : 621.3.011

6793. THE QUESTION OF THE DOMAIN LIMITATION [BEREICHSABGRENZUNG] OF ELECTRICALLY AND MAGNETICALLY POLARIZED MATERIAL. H.Hofmann.
Elektrotech. u. Maschinenbau (EuM), Vol. 73, No. 10,220-6 (May 15, 1956). In German.

A contribution to electromagnetic field theory. A distinction is made between "mathematical" and "physical" limitation and each is investigated. Then the transition from the former to the latter is studied. In the case of a magnetic field the equivalence between magnetic dipoles and elementary electric currents is demonstrated. L.S.Goddard

538.3 : 532.5

6794. THE BOLTZMANN EQUATION AND THE ONE-FLUID HYDROMAGNETIC EQUATIONS IN THE ABSENCE OF PARTICLE COLLISIONS. G.F.Chew, M.L.Goldberger and F.E.Low.
Proc. Roy. Soc. A, Vol. 236, 112-18 (July 10, 1956).

Starting from the Boltzmann equation for a completely ionized dilute gas with no interparticle collision term but a strong Lorentz force, an attempt is made to obtain one-fluid hydromagnetic equations by expanding in the ion mass to charge ratio. It is shown that the electron degrees of freedom can be replaced by a macroscopic current, but true hydrodynamics still does not result unless some special circumstance suppresses the transport of pressure along magnetic lines of force. If the longitudinal transport of pressure is ignored, a set of self-contained one-fluid hydromagnetic equations can be found even though the pressure is not a scalar. A.

538.3

6795. AN ELEMENTARY DERIVATION OF THE FORMULA FOR THE ELECTROMAGNETIC ENERGY IN A DISPERSIVE MEDIUM. M.L.Levin.
Zh. éksper. teor. Fiz., Vol. 29, No. 2 (8), 252 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 168-9 (Jan., 1956).

By examination of energy conservation in a simple oscillatory circuit with resistance, it is concluded that the average electric and magnetic energy densities are, at frequency ω,

$$W_e = \frac{|E|^2}{16\pi}\frac{d}{d\omega}(\epsilon\omega), \quad W_m = \frac{|H|^2}{16\pi}\frac{d}{d\omega}(\mu\omega).$$

J.S.Bell

538.3 : 532.517.4 : 537.591.1

6796. THEORY OF THE ACCELERATION OF CHARGED PARTICLES BY ISOTROPIC GAS MAGNETIC TURBULENT FIELDS. S.A.Kaplan.
Zh. éksper. teor. Fiz., Vol. 29, No. 4 (10), 406-16 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 203-10 (March, 1956).

A kinetic equation is derived to determine the spectrum of fast particles and a method is given for solving this equation for various cases (stationary and non-stationary spectrum account of magnetic-damping losses, etc.). The investigation makes wide use of the method of the theory of shower processes in cosmic rays. A.

538.521.2 : 621.3.013.23

6797. HOMOPOLAR INDUCTION PRODUCED BY ROTATING ELECTROMAGNETS. G.Vallauri.
Mem. Accad. Sci. Torino, Ser. 3a, Vol. 3, Pt I, 14 pp. (Nov. 23, 1955). In Italian.

An evaluation is made of the electric field produced by a cylindrical solenoid, carrying current and rotating about an axis parallel to the geometric axis. The results are confirme by tests. As a second case, tests were made where the axis of the solenoid and the rotation axis coincided. The fundamental differences between the two cases are pointed out. In the first case, the electric field is produced in the whole surrounding space, whilst in the second case, it appears only in the rotor material. The results agree with the new interpretation of the phenomenon of homopolar induction, based on the concept of the granular action of elementary magnets. It also confirms the symmetry between electricity and magnetism (Abstr. 835B/1954; Alta Frequenza, Vol. 22, 211-38, Oct., 1953) and strengthens the application of the same concept to the action of electric particles. R.G.Jakeman

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.561 : 621.385.1.029.6

6798. GROWING ELECTRIC SPACE-CHARGE WAVES. J.H.Piddington.
Austral. J. Phys., Vol. 9, No. 1, 31-43 (March, 1956).

A theory of growing space-charge electric waves, due to Pierce, Haeff, and others, is thought to explain the operation of Haeff's electron-wave tube and other amplifying devices and perhaps the origin of some solar radio emission. The theory is shown to be untenable, the growth predicted being spurious and due to misinterpretation of the dispersion equations. Two rules are given which should be observed when interpreting dispersion equations: (a) The frame of reference in which the dispersion equation is developed should be stationary in the gas in which the waves are propagated; (b) When

choosing real or imaginary parts of frequency or propagation constant for the dispersion equation, the choice must be consistent with physically realizable and relevant conditions. An alternative theory of operation of the electron-wave and other growing-wave tubes is given and some design factors are briefly discussed. A.

538.561

6799. EXCITATION OF SPACE CHARGE WAVES IN DRIFT TUBES. M.Scotto and P.Parzen.
J. appl. Phys., Vol. 27, No. 4, 375-82 (April, 1956).

An analysis has been made of the effect of initial conditions on the excitation of electromagnetic waves in a drift tube. The method employs the Laplace transform which directly includes the initial quantities. Field quantities which have been transformed with respect to the longitudinal coordinate are solved for and the results then inverted. Explicit expressions are then obtained for the velocity, charge density and current density modulations as a series of modes. A.

538.561 : 530.162

6800. FLUCTUATIONS IN OSCILLATING SYSTEMS OF THE THOMSON TYPE. I. S.M.Rytov
Zh. éksper. teor. Fiz., Vol. 29, No. 3 (9), 304-14 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 217-24 (March, 1956).

Fluctuations of phase and amplitude in weakly non-linear oscillating systems amenable, in the periodic mode, to calculation through an expansion in terms of a small parameter are considered. In contrast with previous studies, the Einstein–Fokker equations are not used; instead, symbolic differential equations containing random functions which describe the fluctuations are used in conjunction with methods of correlation theory. The first part of the paper is devoted to a consideration of a system with one degree of freedom; to illustrate the method, the general theory is applied to the case of an isolated system, and to the physical example of a weakly self-excited vacuum-tube oscillator. A.

538.561 : 530.162

6801. FLUCTUATIONS IN OSCILLATING SYSTEMS OF THE THOMSON TYPE. II. S.M.Rytov.
Zh. éksper. teor. Fiz., Vol. 29, No. 3 (9), 315-28 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 225-35 (March, 1956).

The theory developed in Pt I is applied to a non-isolated system with one degree of freedom. A vacuum-tube oscillator synchronized by a harmonic driving force is considered as an example. The same method is applied in the study of a system with two degrees of freedom — a vacuum-tube oscillator coupled to a high-Q circuit — and in the elucidation of the influence of this method of frequency stabilization on fluctuations of amplitude and phase. The way in which thermal fluctuations are taken into account in this theory is considered. A.

538.561

6802. THE ELECTROMAGNETIC FIELD OF A LINEAR EMITTER LOCATED INSIDE AN IDEALLY CONDUCTING PARABOLIC SCREEN. G.A.Grinberg, N.N.Lebedev, I.P.Skal'skaya and Ya.S.Uflyand.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 528-43 (1956). In Russian.

A critical examination reveals that the conclusions made in earlier investigations were without sufficient basis. The problem has now been solved rigorously. It is also shown that in the limiting case of very high frequencies the solution takes the form corresponding to the geometrical optics approximation. A.

538.561 : 538.567.3 : 539.132 : 621.375.9 : 621.373

6803. THEORY OF THE MOLECULAR GENERATOR AND THE MOLECULAR POWER AMPLIFIER. N.G.Basov and A.M.Prokhorov.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 560-3 (1956). In Russian.

The molecular generator uses a transition between molecular energy levels. The oscillating circuit consists of a cavity resonator through which a molecular (e.g. NH_3) beam is passed. Some or all molecules in the beam are at the higher energy level of the transition employed. The coupling between the molecular beam and the oscillator is via the electromagnetic field of the resonator which acts on the dipole moments of the molecules inducing radiation from them. When the conditions of self-excitation are not fulfilled the generator can be used as a microwave power amplifier. The generator involves quantum effects and therefore the theory, given here, is developed on the basis of the quantum mechanical dispersion theory. Formulae are derived for the self-excitation condition of the generator, for the generation frequency and the amplitude of the steady oscillations. The power amplification factor of the molecular amplifier, its pass band and the condition of linear operation are also considered.

538.566

6804. PROPAGATION OF ELECTROMAGNETIC WAVES IN INHOMOGENEOUS LAYERS. II. ABSORPTION OF ELECTROMAGNETIC WAVES. H.G.Haddenhorst.
Z. angew. Phys., Vol. 8, No. 6, 264-7 (1956). In German.

The results of Pt I (Abstr. 4528/1956) are extended to absorbing media. The aim is to achieve a small reflection coefficient over a wide band with a small thickness of absorbing material. An experimental study is carried out of the reflection coefficient of paraffin layers containing graphite and made artificially inhomogeneous by giving them a prismatic or pyramidal structure. L.Pincherle

538.566 : 621.396.11

6805. SCATTERING OF ELECTROMAGNETIC WAVES BY COAXIAL CYLINDERS. A.W.Adey.
Canad. J. Phys., Vol. 34, No. 5, 510-20 (May, 1956).

A scattering system comprising two coaxial, dielectric cylinders has been studied theoretically and experimentally. Calculations have been made of the forward and back scattered fields for several combinations of inner and outer radii. It has been found that, by covering a metal cylinder with a coaxial dielectric shield, it is possible to eliminate to some extent the deep near-field shadow. Experimental results obtained at a wavelength of 3.275 cm using a parallel-plate transmission line are in good agreement with calculations. A.

538.566 : 621.396.11

6806. THE INCIDENCE OF ELECTROMAGNETIC WAVES ON A PAIR OF INFINITE GRIDS. Ya.N.Fel'd.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 1, 71-4 (1956). In Russian.

Two infinite, parallel grids of wires are spaced a short distance apart. A plane wave whose electric vector is parallel to the wires is incident at an arbitrary angle. Formulae are found for the coefficients of reflection and refraction. The grids may be displaced laterally with respect to one another. The coefficients are evaluated for the case of symmetrically staggered arrays of $\lambda/5$ pitch when normally illuminated. Three spacings between grids are taken: 0, $\lambda/4$ and $\lambda/2$. S.C.Dunn

538.566

6807. ELECTROMAGNETIC CROSS-SECTION OF A SMALL CIRCULAR DISC WITH UNIDIRECTIONAL CONDUCTIVITY. G.Toraldo di Francia.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1276-84 (June, 1956).

The scattering of an electromagnetic field by a small circular disk is investigated with the assumption that the disk can conduct current in only one direction. The analysis follows closely that given by Bethe in a similar case. Although Bethe's theory is open to criticism and leads to some wrong results,

the present discussion appears to the author to be prefectly correct. Both the scattering cross-section and the angular momentum cross-section are evaluated. This is sufficient for explaining why the experimental measurement of the torque exerted upon the screen is in poor quantitative agreement with the theory based on the geometric cross-section. A.

538.566

6808. ELECTROMAGNETIC WAVES IN AN IONIZED GAS. P.Rosen.
Phys. Rev., Vol. 103, No. 2, 390-4 (July 15, 1956).

A study is made of the effect of space-dependent electric fields upon the complex conductivity of a low-pressure ionized gas. The case of a standing wave is considered first and it is found that the diffusion constant for the electrons becomes space dependent. Finally the case of a travelling wave in an infinite ionized medium is studied. For the latter situation, the spatial variation of the field has no effect on the conductivity. A.

538.566 : 538.614

6809. CALCULATION OF THE FARADAY EFFECT IN A GYROPARAMAGNETIC MEDIUM. J.Soutif-Guicherd.
C.R. Acad. Sci. (Paris), Vol. 242, No. 15, 1868-71 (April 9, 1956). In French.

The equations developed in a previous paper (Abstr. 5261/1956) are applied to the calculation of the absorption and of the rotation θ_0 of the plane of polarization. θ_0 is in inverse ratio to the wavelength in the guide, does not depend on the transverse values of μ and depends only on the real part of ϵ. L.Pincherle

538.566 : 621.372.8

6810. BROAD-BAND NONRECIPROCAL PHASE SHIFTS — ANALYSIS OF TWO FERRITE SLABS IN RECTANGULAR GUIDE. S.Weisbaum and H.Boyet.
J. appl. Phys., Vol. 27, No. 5, 519-25 (May, 1956).

A compensation technique for broad-banding differential phase shift produced in ferrite loaded rectangular wave guides is discussed. The method involves the use of two magnetized slabs of ferrite on opposite sides of the wave guide, the slabs being different in thickness and in magnetic properties but magnetized in the same direction. The basis of the compensation technique is demonstrated first by a discussion of the thin slab case in which a numerical example showing broad-band differential phase shift is included. An analysis for ferrite slabs of arbitrary thickness is then given and is followed by an example at 6000 Mc/s in 1.59-in. wide guide. The results of this example indicate that a π differential phase shift, constant to within $\pm$ 2.5% in the frequency range 5925-6425 Mc/s, can be obtained using ferrite slabs 5.4-in. long. A scaling principle is discussed and indicates how the numerical results for differential phase shift obtained at 6000 Mc/s in 1.59-in. wide guide can be extended to other frequencies and geometries with the same degree of broad-banding. A.

538.566 : 621.396.677.71

6811. RADIATION PATTERNS OF A DIELECTRIC-COATED AXIALLY-SLOTTED CYLINDER. R.A.Hurd.
Canad. J. Phys., Vol. 34, No. 7, 638-42 (July, 1956).

The azimuthal radiation pattern of an axial slot in a dielectric-coated circular cylinder is derived. Some patterns are computed, and a comparison with experiment made. A.

538.566.2 : 621.396.11.029.6

6812. LONG-RANGE m-, dm- AND cm-WAVES. H.Poeverlein.
Z. angew. Phys., Vol. 8, No. 5, 244-54 (1956). In German.

A review article describing all the mechanisms which cause 1.5 cm to 10 m radio waves to be propagated outside the optical range. Bibliography. J.M.Hough

538.566.3 : 621.396.11

6813. REFLECTION OF RADIO SIGNALS FROM THE IONOSPHERE. P.Poincelot.
Ann. Télécomm., Vol. 11, No. 4, 70-80 (April, 1956). In French.

Mathematical treatment of the propagation of plane e.m. waves in a stratified layer. Both linear and exponential gradients of ionization distribution are considered, and the theory of group velocity is introduced. The influence of the longitudinal component of the earth's magnetic field is also treated. G.M.Brown

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

6814. AN EXAMINATION OF VERWEY'S MODEL FOR THE LATTICE STRUCTURE OF THE FREE SURFACE OF ALKALI HALIDE CRYSTALS. G.C.Benson, H.P.Schreiber and D.Paterson.
Canad. J. Phys., Vol. 34, No. 3, 265-75 (March, 1956).

The Verwey model for the free surface structure of alkali halide crystals at 0°K is used to estimate the effect of surface distortion on the surface energy of these crystals. It appears that the contributions from distortion are considerably larger than previously reported. In the case of some lithium salts the corrected surface energy becomes negative; the mechanical stability of the solid is considered in the light of this. Several aspects of the Verwey model are examined. These include the effect of various repulsive potentials and forms of distortion. A.

539.11

6815. ELECTRONIC STRUCTURE OF THE EXCITON. I. LOCALIZED EXCITON IN KCl. T.Muto and H.Okuno.
J. Phys. Soc. Japan, Vol. 11, No. 6, 633-44 (June, 1956).

The localized excitons of KCl in both optical and X-ray absorption have been worked out by using Wannier–Slater's equation for the perturbed lattice, which may be considered to correspond essentially to the quantum-analogue of von Hippel's semi-classical model of the exciton. The perturbing potential fields in Wannier–Slater's equation are evaluated numerically by the use of Hartree's data and then the best-fit analytical functions are constructed with fair accuracy. The solutions of the equation are obtained by the variational method. The result for the optical exciton is observed to be in fair agreement with the experiment. As for the X-ray exciton, the quantitative comparison with the authors' results can hardly be carried out at present, since the position of the bottom of conduction band cannot be measured accurately for the X-ray absorption spectra. On the basis of our results for X-ray exciton, however, some remarks on the characteristic structure near the absorption edge in KCl are presented. A.

539.11 : 539.132

6816. CALCULATION OF THE COHESIVE ENERGY OF ZINCBLENDE. S.Asano and Y.Tomishima.
J. Phys. Soc. Japan, Vol. 11, No. 6, 644-53 (June, 1956).

The cohesive energy of zincblende has been calculated quantum mechanically by introducing a covalency correction into the usual pure ionic binding. The cohesive energy per ion-pair thus obtained is 1.46 in atomic units which is very near the value of 1.36 derived from the Born–Harber energy cycle and is certainly greater than the value calculated for purely ionic binding by about 60%. This method of calculation would be generally applicable not only for sphalerite-type crystals but also for wurzite-type ones. A.

539.11

6817. THEORY OF SOUND WAVES AND COLLECTIVE DESCRIPTION. T.Nishiyama.
Progr. theor. Phys., Vol. 14, No. 1, 37-51 (July, 1955).

The linearized equation of the density matrix is applied to generalize the theory of sound waves due to Bloch and Tomonaga. It has been shown that the true scattering matrix is given by the oscillator Hamiltonian obtained by this method. The generalized theory of sound waves, which may be considered as a generalized Hartree approximation, is not only capable of yielding the correct plasma frequency and the screening interaction of metallic electrons but facilitates the analysis of the higher-order perturbation. The relationship to Bohm and Pines' collective description is pointed out and a polarization field is introduced in place of the longitudinal electric field. As an example, the electron-lattice interaction is considered , and it is shown that the stability of the atomic lattice increases under the influence of the Coulomb interaction. The limit of applicability of this method is examined by the theory of transformation function. In the Appendix, the correlation energies of some alkali metals are obtained. A.

539.11 : 535.345

OPTICAL ABSORPTION OF COPPER AND SILVER AT 4.2°K. See Abstr. 5786

MOLECULES 539.13

539.13 : 538.561

6818. MOLECULAR RINGING. S.Bloom.
J. appl. Phys., Vol. 27, No. 7, 785-8 (July, 1956).

Semiclassical radiation theory is used to describe the response of an assemblage of two-state molecules driven by an electromagnetic field. When the field is suddenly removed, the assemblage does not immediately become quiescent; it continues to radiate in diminishing amount. This coherent molecular-ringing radiation persists until the molecular populations return to the values they had at the beginning of the driving pulse. Depending upon the strength and duration of the driving pulse, the ringing radiation may exhibit a delayed peak. A.

539.13

6819. ON THE QUENCHING OF MOLECULAR ROTATION OF ORTHO-HYDROGEN IN SOLID STATE. T.Nakamura.
Progr. theor. Phys., Vol. 14, No. 2, 135-50 (Aug., 1955).

By using the data obtained by Hill and Ricketson, one can express the anomalous specific heat C_V of solid hydrogen at sufficiently high temperatures approximately as $C_V T^2/R = \alpha c + \beta c^2$, where $\alpha = 1.1$, $\beta = 15.7$, c = concentration of ortho-hydrogen molecules, T = the absolute temperature, and R = the gas constant. It is the aim of this paper to inquire into the origin of these two terms. Through calculations by the method of moment expansion, the magnitude of β can be explained from the quadrupolar interactions among ortho-molecules, while the anisotropic nature of the valence and van der Waals forces is shown to be effective only as corrective terms. On the other hand, the appearance of α shows that the molecular rotation of an ortho-molecule surrounded by para-molecules should also be quenched. A possible mechanism of this phenomenon may be the rotation-vibration coupling, for which the valence and van der Waals forces should be exclusively responsible. However, it is not yet possible to get a complete understanding of this quenching process. Deviation from the above formula, i.e. the linear dependence on c on the quantity $C_V T^2/R$ at temperatures not high enough is also derived and compared with experiment. Further, a more exact treatment than the moment expansion method is given for the case of low ortho-concentrations and is applied to the case of 7% ortho. A.

539.132 : 535.371

6820. THE DEVELOPMENT OF A FLUORIMETRIC METHOD OF STUDYING THE DURATION OF THE EXCITED STATE OF MOLECULES. A.M.Bonch-Bruevich.
Uspekhi fiz. Nauk, Vol. 58, No. 1, 85-110 (1956). In Russian.

Deals with methods due to Galinin, Bailey and Rollefson, Schmillen, Birks and Little, and with basic errors of measurement in phase fluorimetry. Also a new phase fluorimeter is described. 48 refs. C.R.S.Manders

539.132 : 535.338.4

ANALYSIS OF THE (0, 1) AND (1, 2) BANDS OF THE $^2\Delta - {}^2\pi$ SYSTEM OF CH. See Abstr. 5766

539.132 : 539.133

6821. THE RELATION BETWEEN ELECTRONIC ENERGY LEVELS AND INTERATOMIC DISTANCES IN MOLECULES. F.Sh.Shifrin.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 2, 233-6 (1956). In Russian.

A comparison is made for molecules consisting of two atoms in the same subgroup of the periodic table, in particular of the Cl_2, Br_2 or NaH, KH type. From experimental values in the absorption spectra the following rule is derived: electronic term values are inversely proportional to equilibrium bond lengths. It is shown that this rule also applies to polyatomic molecules and ionization potentials. J.Jacobs

539.132 : 539.133

6822. SPIN ECHOES IN ALCOHOLS AND DERIVATIVES. G.J.B.Crawford and J.S.Foster.
Canad. J. Phys., Vol. 34, No. 7, 653-67 (July, 1956).

The spin-echo technique has been employed to measure the relative chemical shifts and the indirect spin–electron–spin coupling constants between protons at different structural sites in ethyl, propyl, isopropyl, butyl, isobutyl, and amyl alcohols and certain of their derivatives at a Larmor frequency of 29.0Mc/s. The separation between the two r.f. pulses applied to the sample increases regularly in accurately known steps which are controlled electronically. Thus the frequencies modulating the echo envelope have been readily measured with a precision as high as 4% in favourable cases. Relative chemical shifts found by slow passage experiments have been checked with higher accuracy, particularly for the primary alcohols. Encouraged by the implications of these earlier data, the authors have here analysed the longer hydrocarbon chains on the basis of the theoretical computations of Hahn and Maxwell for only two groups of non-equivalent protons. This more precise investigation confirms the assumptions made as to where the major shifts and couplings do and do not exist in the molecular structures. In the halide molecules, it is found that the observed relative chemical shifts are linearly proportional to the paramagnetic fields arising from the valence orbits of the halogens polarized by the external field. Evidence for the particular J-coupling to the hydroxyl group in the alcohols suggests that this bond is effectively stronger in the heavier molecules which are only slightly soluble in water. A.

539.132

6823. TRANSIENT NUCLEAR INDUCTION AND DOUBLE NUCLEAR RESONANCE IN SOLIDS. B.Herzog and E.L.Hahn.
Phys. Rev., Vol. 103, No. 1, 148-66 (July 1, 1956).

The behaviour of transient nuclear induction signals from solids is described by a stochastic model based on a Markoff process. The model assumes the presence of local dipolar field fluctuations in a crystal due to a set B of coupled nuclei. These fluctuations can destroy or enhance the observed precessional coherence of a different set A of nuclei in the crystal. Coupling among A spins is assumed negligible. The spin echo of A formed at a given time t has an amplitude determined by the magnitude and rate R of field fluctuations. For values of Rt between zero and the order of unity the echo amplitude decreases, reaches a minimum at Rt ~ 1, and increas-

es for Rt > 1. For R larger than the spin A static line width (when R = 0) in units of frequency, line narrowing becomes effective, and is reflected in terms of increased lifetime and amplitudes of echo signals. The effect of B spin (Na^{23}) continuous wave resonance upon the echo relaxation of A(Cl^{35}) is studied in $NaClO_3$, a nuclear quadrupole system. For sufficiently weak c.w.r.f. excitation of Na^{23}, the behaviour of Cl^{35} echoes roughly follows the behaviour predicted by the stochastic model for changes in local field fluctuation rate R. The effect of coherent oscillations of local fields at larger c.w. r.f. excitation is discussed. Zeeman splittings of the Na^{23} quadrupole resonance are studied by the double resonance method. The decay of spin echo signals in liquids, as a result of molecular diffusion, is conveniently described by the stochastic model. A.

539.132

6824. ELECTRONIC INTERACTION IN THE FREE-ELECTRON MODEL FOR NON-BRANCHED CONJUGATED SYSTEMS. S.Olszewski.
Acta phys. Polon., Vol. 14, No. 5, 419-31 (1955).

The asymmetrical molecular spin orbitals (ASMO) configurational interaction (CI) method for molecular orbitals of a free electron for non-branched bond systems of conjugated molecules is presented here in close analogy to the ASMO CI theory as developed by Goeppert-Mayer and Sklar and Craig for molecular orbitals in the form of the linear combination of atomic 2p orbitals. This scheme was used to calculate the energy levels in two cases: ethylene and butadiene. The results are in a better agreement with experimental data than those which can be obtained by analogical computations with linear combination of atomic orbitals (LCAO) molecular orbitals (MO) method. This is the case especially in the singlet-triplet separation for the first excited states. In addition a significant decrease in the configuration interaction effect compared with the LCAO MO method was obtained. A.

539.132

6825. EFFECTS OF sp^2 HYBRIDIZATION OF LONE PAIR ELECTRONS ON THE BOND ANGLE OF NITROGEN. H.F.Hameka and A.M.Liquori.
J. chem. Phys., Vol. 24, No. 6, 1262-3 (June, 1956).

The effect of such hybridization for N atoms in s-triazine might explain the fact that the C-N-C angles are smaller than the N-C-N angles. J.Hawgood

539.133 : 537.226.3

6826. NEW EVIDENCE FOR THE PREPONDERANCE OF THE CIS FORM IN ORTHO-CHLOROPHENOL MOLECULE. D.K.Ghosh.
Indian J. Phys., Vol. 29, No. 9, 450-2 (Sept., 1955).

Dielectric loss at 3.18 cm from 20 to 170° C in phenols, such as p-chlorophenol, is attributed to relaxation of the OH group rotation. Absence of loss in o-chlorophenol is attributed to the existence of all molecules in a rigid structure with an internal hydrogen bond to the Cl atom. D.H.Whiffen

539.133 : 537.226.33

ATOMIC DIPOLE MOMENTS IN MOLECULES AND DIELECTRIC RELAXATION. See Abstr. 5845

539.133

6827. CORRELATION OF BOND LENGTH WITH STRETCHING FREQUENCY FOR CARBON-OXYGEN AND CARBON-NITROGEN SYSTEMS. E.M.Layton, Jr, R.D.Kross and V.A.Fassel.
J. chem. Phys., Vol. 25, No. 1, 135-8 (July, 1956).

Graphical correlations of stretching frequencies with bond lengths for C—O and C—N systems in various compounds are presented. The average deviations of the points from the respective curves are 0.023 and 0.020 A. A.

539.133 : 519.1

COMBINATIONAL PROBLEMS SUGGESTED BY THE STATISTICAL MECHANICS OF DOMAINS AND OF RUBBER-LIKE MOLECULES. See Abstr. 5598

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152 : 538.222

6828. DIRECT OBSERVATION OF STATIC NUCLEAR SUSCEPTIBILITIES AT ROOM TEMPERATURE. D.F.Evans.
Phil. Mag. (Ser. 8), Vol. 1, No. 4, 370-3 (April, 1956).

Describes an experiment in which hexamethylbenzene is suspended on a quartz fibre in a strong, inhomogeneous magnetic field. When a strong 30 Mc/s field, modulated 10% in frequency at 40 c/s, is applied there is saturation of the nuclear spin system whose paramagnetism therefore disappears. The increase of diamagnetism of the sample is observed as a rotation. D.H.Whiffen

539.152.1 : 539.172.4

6829. SIMPLE MODEL OF THE Li^6 NUCLEUS AND THE NEUTRON INDUCED REACTIONS ON Li^6. J.Dąbrowski and J.Sawicki.
Acta phys. Polon., Vol. 14, No. 4, 323-35 (1955).

A simple model of the Li^6 nucleus consisting of an α-particle plus a deuteron is discussed. This model is applied to the calculation of the differential cross-section for the $Li^6(n, t)He^4$ and $Li^6(n, d)He^5$ reactions. For the first reaction the pickup mechanism is assumed, for the second one the mechanism of a "knock-out" of a deuteron as a whole from the Li^6 nucleus. The results are compared with experiment. Fairly good agreement is obtained especially for the $Li^6(n, t)He$ reaction for small angles. A.

539.152.1

6830. ON NUCLEAR BINDING BY STATIC TWO-BODY FORCES. D.Emendörfer.
Ann. Phys. (Leipzig), Vol. 17, No. 6-8, 298-316 (1956). In German.

The binding energy of He^4 is calculated on the basis of a static Gaussian potential, chosen to fit the deuteron. The spin—orbit interaction, through the tensor potential, is investigated for various force ranges and nucleon densities. P.T.Matthews

539.152.1

6831. COLLECTIVE EFFECTS IN NUCLEI OF MASS 18 AND 19. F.C.Barker.
Phil. Mag. (Ser. 8), Vol. 1, No. 4, 329-30 (April, 1956).

Elliott and Flowers found (Abstr. 5585/1955) that certain E2 transition rates in O^{17} and F^{19} could not be explained in a simple intermediate coupling shell model calculation, but that the introduction of weak coupling of the Bohr—Mottelson type (Abstr. 7638/1954) between the surface and the nucleons outside the O^{16} core gave good agreement for both nuclei. The effects of such weak coupling are considered here and it is shown that, although it enhances the E2 transition rates in F^{19} by a factor of order 5, it produces only negligible changes in level positions and magnetic moments. L.Pincherle

539.152.1 : 539.164

6832. α-PARTICLE MODEL OF O^{16}. S.L.Kameny.
Phys. Rev., Vol. 103, No. 2, 358-64 (July 15, 1956).

Lifetimes of the four lowest excited states of O^{16} were calculated on the α-particle model and are here compared with experimentally observed values. In addition, the computation of energy levels on each of the two possible level identification schemes has been extended to include all predicted energy levels up to 16 MeV, and compared with the current experimental data. Lastly, the α-particle model was used to

provide the core wave function of a partially-excited-core shell model of O^{17}, and the lifetime of the $\frac{1}{2}^+$ 870 keV state of O^{17} and the electric quadrupole and magnetic moments of the ground state were computed and are compared with experimental values. The energy level predictions on one identification scheme are in excellent agreement with experimental values in the 0-12.95 MeV range, in that of nineteen observed excited levels, fifteen can be matched within 1.1 MeV and three others tentatively matched (depending upon experimental determination of spins and parities); while two levels are predicted but not observed. The lifetime calculations agree to within factors of 15 with experimental values, except for an electric dipole transition which is forbidden on the model. The O^{17} calculations are useful only in evaluating one of the lifetime calculations. A.

539.152.1

6833. INTERACTION CONTRIBUTION TO NUCLEAR ISOMERISM. L.Spruch and A.Rotenberg.
Phys. Rev., Vol. 103, No. 2, 365-73 (July 15, 1956).

A number of observed magnetic multipole isomeric transitions are forbidden on a strict Mayer model of the nucleus, and even on a number of variations thereof, if the ordinary magnetic moment operator is used. Possible explanations include modifications of the nuclear model, of the magnetic moment operator, or of both. Modifications of the operator involve consideration of the currents due to the exchange of mesons between nucleons which give rise to interaction contributions to the magnetic moment operator. An exploratory investigation has been carried out to see to what extent these interaction effects by themselves can account for these so-called forbidden transitions. Using certain simplicity arguments the operators were chosen from the set which can be written down, phenomenologically, with the radial functions arbitrary. The dipole calculations were performed on both the Fermi model and the shell model. On the Fermi model, the transition matrix element involves the unknown radial function only in an integral which is identical for all transitions. By an appropriate but arbitrary choice of the numerical value of this integral, the data can be accounted for, though somewhat crudely; the difference between transitions in odd-proton and odd-neutron nuclei is not explained. There are very few data on "forbidden" octupole transitions; the data that do exist can be more or less understood in terms of the interaction moments. A.

539.152.1

6834. FORMAL THEORY OF NUCLEAR MODELS.
N.Fukuda.
Phys. Rev., Vol. 103, No. 2, 420-5 (July 15, 1956).

The formal theory of nuclear model operators discussed by Eden and Francis is presented from a somewhat different point of view. The method of approach is, first, to introduce the model space M of arbitrary dimension which is composed of simple known wave functions; second, to transform the original Schrödinger equation into that in the model space, the model wave function and the model Hamiltonian being defined in an unambiguous way; third, to obtain the integral equation for the model operator which also determines the model Hamiltonian. This equation no longer contains the exact eigenvalues as in the work of Eden and Francis and is shown to have a unique solution in some cases. The formal relation of this theory to the nuclear scattering problem is discussed. A.

539.152.1

6835. CALCULATIONS WITH THE OPTICAL MODEL OF THE NUCLEUS. C.B.O.Mohr and B.A.Robson.
Proc. Phys. Soc. A, Vol. 69, Pt 5, 365-74 (May, 1956).

The optical model of the nucleus is used with the phase shift method to calculate the scattering of 340 MeV neutrons and protons in carbon and lead, and of 4, 14, 36 and 100 MeV neutrons in nitrogen, for different forms of potential well and with different amounts of nuclear absorption. The results are used to establish the range of validity of the approximations of Born, of Montroll and Greenberg, and of Fernbach, Serber and Taylor. The latter gives remarkably accurate values over a wide energy range for the total elastic and absorption cross-sections and forward elastic scattering. It is the only approximation which gives a satisfactory account of the effect of absorption. Unfortunately it does not give the angular distribution simply, and the most accurate approximation which does so, that of Montroll and Greenberg, has a very limited range of validity. Comparison with the experimental angular distributions of 340 MeV protons in carbon and lead leads to limited conclusions about the nuclear potential. An approximate calculation of the angular distribution of the scattering of 22 MeV α-particles in silver and lead indicates that the optical model can account for the observed results in terms of a rounded-off potential well. A.

539.152.1

6836. ON THE GAMMA-TRANSITION OF NUCLEI.
M.Sano.
Progr. theor. Phys., Vol. 14, No. 2, 81-94 (Aug., 1955).

Using A.Bohr's collective model, the gamma-transition of nuclei is studied by the approximations of weak and strong couplings. In the M4-transition, the agreement of experimental data with theoretical results is in general much better on this model than that predicted on other nuclear models, if the strong coupling approximation is adopted. The results of these two approximations are compared with one another. The difference between them comes from contributions due to a deformed core. The contributions, and consequently the difference between the weak and strong coupling approximations, increase with the order of multipolarity of radiation. In E3-transitions (j-forbiddenness), such as those between $p_{1/2}$ and 7/2 + states, it is necessary to take into account the nuclear configuration mixing due to the surface coupling. Especially, the coupling with deformations of order three is important for these transitions. A.

539.152.1

6837. NUCLEAR STRUCTURE AS REVEALED BY ELECTRIC EXCITATION. C.Goodman.
Progr. theor. Phys., Vol. 14, No. 2, 95-106 (Aug., 1955).

From the electric excitation of low-lying levels in medium weight and heavy nuclei the energy ΔE of a given level and the cross-section σ_{ex} for its excitation can be deduced. Electric quadrupole moments, $Q_0(\Delta E)$ and $Q_0(\sigma_{ex})$ respectively, based on these two sets of data show markedly different values and markedly different trends as the closed proton shells at 50 and 82 are approached. If it is assumed that the $Q_0(\Delta E)$ is indicative of the deformation of mass and $Q_0(\sigma_{ex})$ is indicative of the deformation of charge, the results suggest that (a) the protons and neutrons are not uniformly distributed throughout the nucleus, (b) the spherical symmetry of the protons is greater than that of the neutrons near the proton shells, (c) the protons are concentrated closer to the centre of the nucleus than the neutrons, and/or (d) the flow within the nucleus is not purely irrotational. A.

539.152.1

6838. SEPARATION ENERGIES AND NUCLEAR STRUCTURES IN LIGHT NUCLEI. T.Tati.
Progr. theor. Phys., Vol. 14, No. 2, 107-25 (Aug., 1955).

The separation energies of light nuclei $10 \lesssim A \lesssim 50$ are considered in relation to the nuclear structure. We can grasp the physical meaning of the complicated variation of the separation energies of nucleons from nucleus to nucleus phenomenologically, by comparing them with the contributions to the separation energies from each term of the semi-empirical mass formula. The systematic deviation of the separation energies from the semi-empirical mass formula disappears with the corrected mass formula of the uniform model which assumes the two-body interactions betweem symmetric pairs in supermultiplet structure. This fact strongly supports that the symmetry effect of the nuclear binding energy originates from the above mentioned two-body interactions. The devia-

tions of the separation energies from the corrected mass formula of the uniform model support the independent particle model. In this mass region, the nucleus has, besides the dominant supermultiplet structure, the j–j coupling shell structure. The comparison between the mass formula and the above mentioned potential energy of two-body interactions which give the symmetry effects quantitatively, and the requirement that the separation energy is nearly equal to the depth of the energy level of the last nucleon measured from the top of the potential in the independent particle model, lead us to the conclusion that there are other kinds of nuclear energies which are not sensitive to the symmetry effect and to the "expansibility" of the nucleus, and bear about a half of the total potential energy of the nucleus. The depth of the average potential for the last nucleon is estimated to be about 50 MeV and is a linearly decreasing function of X (X = Z – N for protons, X = N – Z for neutrons). A.

539.152.1

6839. DISTRIBUTION OF ANGULAR MOMENTUM AND SPATIAL DISTRIBUTION OF NUCLEONS IN NUCLEI. S.I.Larin.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 587-9 (1956). In Russian.

The types of spatial distributions consistent with the mean square angular momentum, known from the shell model, are discussed. G.E.Brown

539.152.1

6840. ISOMERIC STATES IN DEFORMED NUCLEI. L.K.Peker.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 616-17 (1956). In Russian.

States in odd A nuclei are discussed. It is shown that qualitative facts about the place of occurrence of isomers, which cannot be explained in the independent particle model, follow simply from the collective motion. G.E.Brown

539.152.1

6841. NUCLEAR SHELLS AND THE CLASSIFICATION OF ATOMIC NUCLEI. A.V.Savich.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 501-10 (1956). In Russian.

A nuclear shell model is proposed. The model is used to classify the spins and magnetic moments of the ground and metastable levels of nuclei of odd mass number and also the masses and β-disintegration data of the light nuclei of odd mass number. A.

539.152.2

6842. ON THE CALCULATION OF NUCLEAR MOMENTS ACCORDING TO THE SHELL MODEL. T.Kassecker and P.Urban.
Acta phys. Austriaca, Vol. 10, No. 1-2, 95-126 (1956). In German.

General expressions are obtained for the magnetic moment and the quadrupole moment, assuming that each nucleon can be treated by the Hartree approximation. A spherically symmetric oscillator potential is assumed with strong spin–orbit coupling. Numerical values are obtained for the magnetic moments of N^{15} and O^{17}, in good agreement with experimental values. J.Hughes

539.152.2

6843. ISOTOPIC SPIN SELECTION RULES. VII. BREAKDOWN OF THE RULES AND THE SITUATION IN ^{16}O. D.H.Wilkinson.
Phil. Mag. (Ser. 8), Vol. 1, No. 5, 379-92 (May, 1956).

For Pt VI see Abstr. 5307 (1956). Factors governing the breakdown of the isotopic spin selection rules are discussed. Two energy ranges exist within which the rules can be expected to be obeyed; at low excitation individual excited states are well separated in energy and have a good isotopic spin purity so that the rules are obeyed in reactions passing through such states only; at high excitation individual states no longer have a well-defined isotopic spin but the rules are obeyed because many overlapping levels are simultaneously excited in a total state of initially well-definied isotopic spin which breaks up before the Coulomb forces have had time to cause much isotopic spin mixing. In between these regions where the rules are obeyed (although for very different reasons) severe breakdown is to be expected. The approximate extent of these reasons is discussed. The experimental situation as regards the operation of the rules and other consequences of charge independence is examined in O^{16} where knowledge is available relating to the effective isotopic spin purity of ten energy levels or energy ranges between 6 and 30 MeV excitation. Good correspondence with theoretical expectation is found in the above described general trend of effective impurity versus excitatio It is concluded that the situation is adequately described by th Coulomb perturbation of an otherwise charge independent (syn metric) Hamiltonian. A

539.152.2

6844. ON THE LITHIUM RESONANCE IN LITHIUM SULFATE MONOHYDRATE $Li_2SO_4.H_2O$. M.Murakami and E.Hirahara.
J. Phys. Soc. Japan, Vol. 11, No. 5, 607 (May, 1956).

The Li nuclear magnetic resonance is affected by quadrupole coupling with the water of hydration in $Li_2SO_4.H_2O$ and fo most orientations of a single crystal five lines appear even though I = 3/2. Semi-quantitative agreement with the crystal structure was obtained, but small discrepancies are probably due to the assumption, in the theoretical treatment, of a cylindrically symmetrical electric field at the Li nucleus. D.H.Whiffen

539.152.2

6845. NUCLEAR MAGNETIC RESONANCE IN MOLECULAR CHLORINE COMPOUNDS. Y.Masuda.
J. Phys. Soc. Japan, Vol. 11, No. 6, 670-6 (June, 1956).

Measurements of the chemical shifts and the transverse and longitudinal relaxation times of chlorine nuclear magnetic resonance of such liquid chlorine compounds as $TiCl_4$, $VOCl_3$, CrO_2Cl_2 and $SiCl_4$, whose quadrupole coupling constants were measured by Dehmelt by means of the pure quadrupole resonance experiment. Line widths are nearly proportional to the square of the quadrupole coupling constant. The equalit of the transverse relaxation time T_2 and the longitudinal relax tion time T_1 has been verified experimentally in these compounds. Solomon's method for the calculation of T_1 and T_2 wa applied to a quadrupole relaxation. T_1 is exactly equal to T_2 in cases where quadrupole relaxation is essential, the molecular surroundings are isotropic, and further the extreme narrow conditions are well established. This result is identical to Wangsness and Bloch's. Experimental T_1 values are about ten times larger than the theoretical one and the reason of the discrepancy is discussed. Estimate of chemical shift by d-electron is given. A.

539.152.2

6846. A SENSITIVE AND STABLE NUCLEAR INDUCTION HEAD. E.A.Richards, G.Phillips and W.K.Campe.
J. sci. Instrum., Vol. 33, No. 7, 260-2 (July, 1956).

Details are given of the construction and performance of a "crossed coil" induction head, for the detection of nuclear magnetic resonance in 0.1 cm^3 specimens, in which the condition of maximum sensitivity is achieved through the operation of a single manual control. The simple method of construction provides, at the optimum setting, a decoupling of 80 dB between the coils which remains constant to within 0.4 dB over a period of a week. A.

539.152.2 : 539.166

6847. INFLUENCE OF THE TIME-DEPENDENT QUADRUPOLE INTERACTION ON THE DIRECTIONAL CORRELATION OF THE Cd^{111} GAMMA RAYS. R.M.Steffen.
Phys. Rev., Vol. 103, No. 1, 116-25 (July 1, 1956).

The influence of the time-dependent quadrupole interaction in various liquid sources of In^{111} on the directional correlation of the Cd^{111} gamma-rays has been investigated quantitatively. By using the technique of delayed correlation measurements the characteristic interaction (relaxation) parameters λ_2 have been determined for aqueous $InCl_3$ solutions as a function of the macroscopic viscosity. These experiments revealed that λ_2 is not simply proportional to the macroscopic viscosity of the liquid as might be expected from simple considerations. The extranuclear interaction in indium metal sources was studied as a function of temperature. The relatively large attenuation of the Cd^{111} gamma—gamma correlation in polycrystalline indium metal was found to vanish completely upon reaching the liquid phase, a result which was confirmed by delayed correlation measurements. The "true", unperturbed, directional correlation of the Cd^{111} gamma-rays was computed from these experimental data and is represented by $W(\Theta) = 1 - (0.180 \pm 0.002)P_2(\cos\Theta) + (0.002 \pm 0.003)P_4(\cos\Theta)$. This correlation is characteristic for a cascade of a mixed M1 + E2 transition, with an E2/M1 intensity ratio of $0.021 \pm 0.002(\delta = + 0.146)$ followed by a pure E2 transition, between states of angular momentum quantum number 7/2, 5/2 and 1/2. A.

539.152.2 : 539.166

6848. MAGNETIC MOMENT OF THE 247-keV EXCITED STATE OF Cd^{111}. R.M.Steffen and W.Zobel.
Phys. Rev., Vol. 103, No. 1, 126-33 (July 1, 1956).

The magnetic moment of the 247 keV (I = 5/2) excited state of Cd^{111} was determined from the effects of an external magnetic field on the directional correlation of the Cd^{111} gamma-rays. Two methods of measurement were employed. The observation of the attenuation of the directional correlation yielded for the magnetic moment $|\mu_{5/2}| = (0.80 \pm 0.04)$ n.m. taking into account the time-dependent quadrupole interaction in the liquid sources which were used for this measurement. The more accurate method of determining the azimuthal shift of the correlation pattern about the axis of the magnetic field gave a more precise value of the magnetic moment, $\mu_{5/2} = -(0.783 \pm 0.023)$ n.m. A.

539.152.2

6849. BOLOMETER DETECTION OF NUCLEAR QUADRUPOLE RESONANCE. H.G.Robinson.
Rev. sci. Instrum., Vol. 27, No. 3, 163-4 (March, 1956).

The possibility of using bolometer detection for quadrupole resonance is investigated. Preliminary results in the 30 Mc/s region indicate that such a detection method can be made to operate easily and at a sensitivity comparable to conventional regenerative detectors. Scaling to other frequencies should be possible without the difficulties encountered in regenerative and super-regenerative detectors. A.

539.152.2

6850. NON-STATIONARY PRECESSIONAL MOTION OF PARAMAGNETIC NUCLEI. G.Krüger and G.Laukien.
Z. Phys., Vol. 145, No. 4, 456-68 (1956). In German.

The Bloch differential equations for nuclear resonance are integrated for the initial non-stationary motion.

D.H.Whiffen

539.153 : 518.5

6851. COMPUTATION OF ATOMIC ENERGY LEVELS: SPECTRUM OF SINGLY-IONIZED TANTALUM (Ta II). R.E.Trees, W.F.Cahill and P.Rabinowitz.
J. Res. Nat. Bur. Stand., Vol. 55, No. 6, 335-41 (Dec., 1955).

Energies and wave-functions of atomic systems can be calculated as the characteristic values and vectors of matrices in accordance with long-established procedures. Coding for carrying out these computations on the Standards Eastern Automatic Computer is described. Some preliminary values are given for the energy levels of the spectrum of singly-ionized tantalum (Ta II). A.

539.153

6852. FINE STRUCTURE OF n = 3 HYDROGEN BY A RADIO-FREQUENCY METHOD. W.E.Lamb, Jr and T.M.Sanders, Jr.
Phys. Rev., Vol. 103, No. 2, 313-14 (July 15, 1956).

A radio-frequency measurement of the fine structure of hydrogen atoms in the n = 3 state is described. Transitions $3\,^2S_{1/2} \leftrightarrow 3\,^2P_{1/2}$, $3\,^2S_{1/2} \leftrightarrow 3\,^2P_{3/2}$, and $3\,^2P_{3/2} \leftrightarrow 3\,^2D_{5/2}$ have been observed. In this experiment r.f.-induced transitions are detected by their effect on the intensity of H_α radiation emitted by the atoms. Preliminary results are in agreement with the predictions of quantum electrodynamics to within the accuracy of the present measurements, namely ± 10 Mc/s. A.

539.153

6853. HYPERFINE STRUCTURE OF Rb^{85}, ^{87} IN THE 5P STATE. B.Senitzky and I.I.Rabi.
Phys. Rev., Vol. 103, No. 2, 315-21 (July 15, 1956).

The atomic beam resonance method has been used to investigate the hyperfine structure of the 5P excited states of Rb^{85} and Rb^{87}. The apparatus and method of observation were similar to those in a previous experiment on the 3P state of sodium. For Rb^{85} in the $5P_{3/2}$ state, the magnetic dipole and electric quadrupole interaction constants are, respectively, $a_{3/2} = 25.3 \pm 0.2$ Mc/s and $b = 24.4 \pm 1.3$ Mc/s, and for the $5P_{1/2}$ state, $a_{1/2} = 120.7 \pm 1$ Mc/s. For Rb^{87}, the three constants are $a_{3/2} = 85.8 \pm 0.7$ Mc/s, $b = 11.8 \pm 0.6$ Mc/s, and $a_{1/2} = 409 \pm 4$ Mc/s. The quadrupole moments are $Q_{85} = (0.27 \pm 0.02) \times 10^{-24}$ cm^2 and $Q_{87} = (0.13 \pm 0.01) \times 10^{-24}$ cm^2, which agree with the moments calculated from the hyperfine structure of these isotopes in the 6P state as measured by another technique. A.

539.153

6854. EFFECT OF CORE EXCITATION ON THE HYPERFINE STRUCTURE OF RUBIDIUM. M.Phillips.
Phys. Rev., Vol. 103, No. 2, 322-3 (July 15, 1956).

Perturbations of the ratio of hyperfine coupling constants for the 5P levels of rubidium are investigated. The excitation of one 4s electron to higher s orbits is most effective in altering the ratio $a_{1/2}/a_{3/2}$, although the effect of 4p shell excitation may be perceptible. The fraction of excited 4s configuration in the 5P state is written in terms of matrix elements of the electrostatic interaction, from which it appears that the sign of the perturbation is in agreement with the discrepancy observed by Senitzky and Rabi. A.

539.153

6855. CALCULATION OF μ-MESIC ENERGY LEVELS IN HEAVY ATOMS. S.Brenner.
Phil. Mag. (Ser. 8), Vol. 1, No. 5, 432-40 (May, 1956).

Energy levels are calculated for various nuclear charge distributions. Only the Coulomb attraction between the μ-meson and the nucleus is considered. It is found that the energy levels are almost independent of small changes in the charge distribution provided the 'radius of the distribution' defined by the fourth moment of the distribution) is kept constant. The calculations were done with the aid of a desk machine. The methods used are fairly simple and can easily be used with any reasonable charge distribution. A.

539.153.4

6856. FERMI PART η_0 OF THE TF (THOMAS—FERMI) FUNCTION FOR FREE POSITIVE ION. S.Kobayashi.
J. Phys. Soc. Japan, Vol. 11, No. 5, 609 (May, 1956).

A table of numerical values of η_0 and η_0' is given, using for the calculations the values of the TF function ϕ_0 for the free atom given previously (Abstr. 572/1956). J.Hughes

PA

539.153.4

6857. GROUND-STATE SOLUTION OF THE NONRELATIVISTIC EQUATION FOR HELIUM. H.M.Schwartz.
Phys. Rev., Vol. 103, No. 1, 110-11 (July 1, 1956).

By the inclusion of half-integral powers in the Hylleraas functions for the ground state of the helium atom, it is possible to obtain more rapid convergence in the Ritz variational method applied to the nonrelativistic Schrödinger equation (for infinite nuclear mass), as shown by results of calculations involving from four to thirteen parameters. The energy obtained with 13 parameters, −2.903719 a.u., is the lowest so far published. The coefficients for the normalized wave functions are given. A.

539.153.4 : 539.132

THE DENSITY MATRIX IN SELF-CONSISTENT FIELD THEORY. GROUND STATE OF THE Be ATOM. See Abstr. 6061

539.155.2

6858. CONTINUOUS MEASUREMENT OF DEUTERIUM CONCENTRATION IN HYDROGEN BY MEANS OF THERMAL CONDUCTIVITY. M.Silvestri and N.Adorni.
Rev. sci. Instrum., Vol. 27, No. 6, 388-91 (June, 1956).

A continuous analytical device for the measurement of deuterium concentration in hydrogen gas is described, based on differences in the thermal conductivities of the hydrogen isotopic molecules and the use of a Gow-Mac thermal conductivity unit. Calibration of the apparatus in the range 0-2.5% D/(D + H) was performed, showing that accuracy of the order of 1/10 000 can easily be achieved with well purified gases. A.

539.155.2

6859. ISOTOPE SPECTRUM ANALYSIS. A.R.Striganov.
Uspekhi fiz. Nauk, Vol. 58, No. 3, 365-414 (1956). In Russian.

Account is given of the available methods. Also considered is the dependence of the relative intensity of isotope lines upon the relative concentration of those isotopes and the application of the relation in isotope spectrum analysis. The cases of the spectra of H^1 and H^2 gaseous mixtures, heavy water, Li, U are discussed. 40 refs. C.R.S.Manders

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.163

6860. DECAY OF THE CERIUM-139 ISOMERS.
B.H.Ketelle, H.Thomas and A.R.Brosi.
Phys. Rev., Vol. 103, No. 1, 190-5 (July 1, 1956).

The decay of the 140-day ground state of Ce^{139} has been reinvestigated. A 4π scintillation spectrometer has been used to show that K-electron capture transitions between ground states is less than one % of all K-electron captures. The same instrument has been used to measure the fraction of all transitions which terminate at the 166 keV level due to K-electron capture, and also has been used to determine the conversion coefficient of the 166 keV transition. The K-conversion coefficient was found to be 0.22 ± 0.01. K-electron capture accounts for 73% of all transitions to the 166 keV level. The energy available for decay to the excited level is 104 ± 6 keV as computed from the experimental capture ratio. A value of 0.88 ± 0.01 was obtained for the K-fluorescence yield at Z of 57 from beta-ray spectrometer measurements and coincidence counting. An isomeric level of 740 ± 5 keV above the ground state of Ce^{139} has been found. The half-life of the transition is 55 ± 3 sec and its K-conversion coefficient is 0.08 ± 0.02. Mass and element assignments have been established and approximate cross-sections for activation of each level in Ce^{139} by the (n, γ) reaction on Ce^{138} in the graphite reactor have been determined. A.

539.163

6861. ALPHA AND SPONTANEOUS FISSION HALF-LIVES OF PLUTONIUM-242. J.F.Mech, H.Diamond, M.H.Studier, P.R.Fields, A.Hirsch, C.M.Stevens, R.F.Barnes, D.J.Henderson and J.R.Huizenga.
Phys. Rev., Vol. 103, No. 2, 340-1 (July 15, 1956).

Measurements on Pu^{242} samples, highly enriched by neutron irradiation, resulted in the alpha half-life value of $(3.88 \pm 0.10) \times 10^5$ years and in the spontaneous fission half-life value of $(7.06 \pm 0.19) \times 10^{10}$ years. A

539.163.2

6862. ON THE ELECTRON CAPTURE DECAY ENERGY OF $^{153}_{64}Gd$. R K.Gupta and S.Jha.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 88-95 (July, 1956).

The summing technique in a scintillation spectrometer has been used to determine the electron capture decay energy of Gd^{153}. The decay energy is 225^{+15}_{-13} keV. The internal conversion coefficients of the 102 keV γ-ray have been measured in the scintillation spectrometer. The K conversion coefficient of this γ-ray is 0.61 ± 0.03 and $K/(L + M) \simeq 5$. It has been estimated that about 25% of the transitions go to the ground state of Eu^{153}. A.

539.163.

6863. RADIOACTIVE DECAY OF Yb^{177}. J.P.Mize, M.E.Bunker and J.W.Starner.
Phys. Rev., Vol. 103, No. 1, 182-5 (July 1, 1956).

The decay characteristics of the 1.8 hr negatron emitter Yb^{177} have been investigated by means of beta-ray and gamma ray coincidence scintillation spectrometers. Gamma-rays of energies 0.118, 0.140, 0.147, 0.95, 1.09, 1.12 and 1.24 MeV are found to accompany the decay. The gamma-ray energy and intensity data can be satisfied by postulating excited level in Lu^{177} at 0.118, 0.147, 0.287 and 1.24 MeV. Beta–gamma coincidence scintillation spectrometer studies indicate that the 0.118, 0.147 and 1.24 MeV levels as well as the ground state of Lu^{177} are directly populated by beta decay from Yb^{177}. Tentative spin and parity assignments for the excited levels of Lu^{177} are presented. A

539.163.2

6864. DECAY OF Co^{58}. H.Frauenfelder, N.Levine, A.Ros and S.Singer.
Phys. Rev., Vol. 103, No. 2, 352-5 (July 15, 1956).

Co^{58} decays not only to the first but also to the second excited state of Fe^{58}. Both of these states in Fe^{58} possess spin 2, even parity, and the transition between them is a mixture of E2 and M1, with a mixing ratio $\delta(E2/M1) = +2.2 \pm 0.3$. The intensities of the 1.62 MeV and 0.81 MeV gamma-rays originating from the second excited state (relative to the main 0.81 MeV transition) are 0.005 ± 0.001 and 0.016 ± 0.005, respectively. A.

539.164

6865. DEPENDENCE OF ALPHA DISINTEGRATION ENERGY ON PROTON AND NEUTRON NUMBERS.
Y.P.Varshni.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1148-9 (May, 1956).

The empirical relation $E_d = 0.4Z - 1.795(N - 132)^{1/3} - 26.208$ is suggested for the α disintegration energy E_d for nuclei with $N > 132$. The average percentage error between the observed and calculated values of E_d is ± 3.6. J.Hughes

539.164.75

6866. IONISATION LOSS OF α-PARTICLES AT LOW ENERGIES BELOW 4 MeV. K.L.Kaila.
Indian J. Phys., Vol. 29, No. 10, 479-89 (Oct., 1955).

No quantitative theory seems to have been given so far for the ionization loss of α-particles at low energies below 4 MeV due to the extremely complicated phenomenon of electron capture by the α-particle occurring in this region. Here an attempt is made to get a complete expression for the ionizatio

loss of α-particles in this region by transforming Bethe's theoretical expression (which is valid only at high energies) and introducing some new terms to take account of electron capture and finally fitting it empirically with the Holloway and Livingston single α-ionization curve. A theoretical interpretation of the new form of the relation has also been given. Further, using this new expression an empirical range–energy relation is obtained which gives quite satisfactory agreement with the observed range–energy relation of α-particles in the region 2.5 MeV downwards. A.

539.164.75

6867. RANGE–ENERGY RELATION FOR LOW-ENERGY ALPHA PARTICLES IN Si, Ge, AND InSb. G.W.Gobeli.
Phys. Rev., Vol. 103, No. 2, 275-8 (July 15, 1956).

The range–energy relations for alpha-particles in Ge, Si, InSb, Al, Cu, Ag and Au were determined by measuring the air equivalents of thin foils of the materials. The incident alpha-particles had energies between 0.7 MeV and 4.45 MeV, which were obtained from a Po^{210} source with air as a variable absorber. A CsI(Tl) crystal was employed as the detector and the pulse-height distributions of the alpha particles were observed with a 20-channel pulse-height analyser. Approximate analytical expressions for the ranges in microns in Si, Ge and InSb for alpha-particle energies above 0.5 MeV are: $R_{Si} = 2.13E^{1.45} + 2.20$, $R_{Ge} = 1.95E^{1.34} + 1.72$, and $R_{InSb} = 2.08E^{1.30} + 1.65$. The ranges for the semiconductors interpolate smoothly between those of the metals, which are in good agreement with available data. A.

539.164.9 : 537.542

6868. LIGHT PULSES EXCITED BY α PARTICLES IN ARGON. A GASEOUS SCINTILLATION DETECTOR. M.Forte.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1443-55 (June, 1956).

The light pulses produced by the passage of individual α-particles through gases have been detected and analysed by means of a suitable experimental technique. The time shape of pulses obtained with argon of various purities is studied with respect to the mechanism of photon production. The possibilities are considered of particle detectors based on gas scintillation. A scintillation chamber filled with argon was found to be suitable for the spectral analysis of α-particles, yielding a 13% resolution at ~5 MeV, for example. The resolving time of this instrument is very short. A.

539.165 : 539.166

6869. β-γ ANGULAR CORRELATION OF $^{208}_{81}Tl$(ThC''). F.Demichelis and R.A.Ricci.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 96-105 (July, 1956).

The angular correlation between the 2.37 MeV β-radiation and the 2.62 MeV γ-ray in $Tl^{208} \rightarrow Pb^{208}$ decay has been measured and found anisotropic. The value of the anisotropic coefficient is $-(0.585 \pm 0.06)$. Assuming the spin and parity assignment for the excited levels of Pb^{208} suggested by Elliot et al., $J = 4+$ is deduced for the Tl^{208} ground state. On the basis of the various experimental results, the most reliable assignment of the spin and parity for the Bi^{212} ground state should be $J = 1-$ or $2-$ according to the assignment suggested by Martin and Parry and to the order of forbiddeness of the Bi^{212} β-transitions. A.

539.165 : 539.166

6870. EXPLICIT FORMULAE OF BETA-GAMMA DIRECTIONAL CORRELATION. M.Morita.
Progr. theor. Phys., Vol. 14, No. 1, 27-36 (July, 1955).

The β-γ directional correlation function is expressed as a series in the Legendre polynominals:

$$\omega(\theta) = \sum_{L_1 \leq L_2} \sum_{n} c^{(2n)}_{L_1L_2} b^{(2n)}_{L_1L_2} P_{2n}(\cos\theta),$$

where $c^{(2n)}_{L_1L_2}$'s are the numerical coefficients which depend upon the spin assignments of the nuclei and the multipolarities of γ-ray. Their numerical values are tabulated for the most interesting transition schemes. The parameters for the β-ray, $b^{(2n)}_{L_1L_2}$, are also given in a form convenient for analysis of the experimental data. A.

539.165 : 539.152.1

6871. NUMERICAL VALUES OF THE CONSTANT OF THE TRIPLET BETA-INTERACTION. D.A.Frank-Kamenetskiĭ.
Zh. éksper. teor. Fiz., Vol. 29, No. 1(7), 135-6 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 1, 162-3 (Jan., 1956).

From experimental data, the ratio $R = g^2_{GT}/g^2_F$ was found to be between the limits $3.18 \geq R \geq 1.82$, and for the triplet interaction, the constant $A = 2\pi^3 \ln 2 \hbar^7/m_0^5 c^4 g^2_{GT}$ must lie within the limits $3600 \geq A \geq 2060$ sec. These values are used to determine the nuclear matrix elements for certain mirror nuclei transitions. J.Hughes

539.165 : 537.542

A BETA-RAY SCINTILLATION SPECTROMETER WITH OPTIMUM RESOLUTION. See Abstr. 5967

539.165.2 : 530.145

6872. β-RAY SPECTRUM OF RaE. H.Takebe, S.Nakamura and M.Taketani.
Progr. theor. Phys., Vol. 14, No. 4, 317-36 (Oct., 1955).

It is shown that the beta-ray spectrum of RaE can be explained in the Fermi theory in terms of the scalar plus tensor interaction for the selection rule, $\Delta J = \pm 1$, yes. In this attempt, the simultaneous contribution to the electron wave-function of the finite de Broglie wavelength effect and the finite nuclear radius effect is reasonably taken into account for the first time. As far as the present calculation is concerned, the relative sign of the weight of the scalar and tensor interaction cannot be determined. A.

539.166

6873. GAMMA–GAMMA ANGULAR CORRELATION IN ^{160}Dy. G.Bertolini, M.Bettoni and E.Lazzarini.
Nuovo Cimento (Ser. 10), Vol. 3, No. 5, 1162-5 (May, 1956).

Using NaI(Tl) scintillation counters in coincidence, this was found to be $W(\theta) = (1 \pm 0.023) + (0.105 \pm 0.035)P_2(\cos\theta) - (0.0014 \pm 0.036)P_4(\cos\theta)$. Since this measured correlation is a composite of two separate correlations, 300-880 keV and 300-970 keV, only tentative level assignments can be made. J.Hughes

539.166

6874. GAMMA TRANSITIONS IN Ta^{181}. F.Boehm and P.Marmier.
Phys. Rev., Vol. 103, No. 2, 342-3 (July 15, 1956).

The nuclear spectrum of Ta^{181} has been investigated. The excited levels have energies of 136.25, 482.0, 615.0, 618.9 and 958.0 keV. The gamma-ray energies are 3.9, 133.02, 136.25, 136.86, 345.85, 476.0, 482.0 and 615.5 keV. Multipolarities for the gamma-rays are given and spin assignments to the levels are proposed. A.

539.166

6875. GAMMA RADIATION IN RaD AND RaE DECAY. R.W.Fink, G.W.Warren, R.R.Edwards and P.E.Damon.
Phys. Rev., Vol. 103, No. 3, 651-5 (Aug. 1, 1956).

By using chromatographically separated, carrier-free sources, the electromagnetic spectra of RaD and RaE have been investigated from 4 to 60 keV with an argon-methane gas proportional spectrometer. No gamma-rays or L X-rays were detected in the decay of RaE. Aside from the principal 46.5 keV transition, no gamma-rays (< 0.2% of the 46.5 keV photons) were observed in the decay of freshly-purified RaD. However, when equilibrium mixtures of RaDEF, from spent radon seeds less than 2 years old, were examined through aluminium

absorbers of thickness sufficient to eliminate pile-up peaks (20 to 26 keV) from the L X-rays (10 to 16 keV), a broad peak at about 31 keV appeared; it was established conclusively that in reality this is external beta-bremsstrahlung of RaE, whose low-energy region has been attenuated selectively so as to give the appearance of a gamma-ray peak. A chromatographic column separation of millicurie quantities of carrier-free RaD and RaE from each other, as well as from RaF and macro amounts of gold and mercury impurities, is described. The time required for separation is less than 2 hours. A.

539.166

6876. MEASUREMENTS OF THE ANISOTROPY OF GAMMA RADIATION EMITTED BY ORIENTATED ^{52}Mn NUCLEI. W.J.Huiskamp, M.J.Steenland, A.R.Miedema, H.A.Tolhoek and C.J.Gorter.
Physica, Vol. 22, No. 7, 537-94 (July, 1956).

Measurements are reported of the anisotropy of the intensity of the gamma radiation emitted by Mn^{52} nuclei, orientated at low temperatures. The nuclei were orientated in Ce Mg nitrate single crystals both by the alignment method and by polarization in an external magnetic field. From the results it is concluded that the spins of the 3 excited states of Cr^{52} are 2, 4 and 6, all radiations being E2. The alignment anisotropy as a function of temperature showed an unusual character, which is compared with the results obtained by the Oxford group on Mn^{54}. A.

539.166.08 : 535.376

PEAK EFFICIENCY OF NaI. See Abstr. 5797

539.166.08 : 539.172.4

6877. GAMMA-RAY DOSAGE IN INHOMOGENEOUS NUCLEAR REACTORS. W.Primak.
J. appl. Phys., Vol. 27, No. 1, 54-62 (Jan., 1956).

Methods for estimating the gamma-ray dosage in samples undergoing irradiation in nuclear reactors are developed. They are applied to the calculation of the dosage in inhomogeneous reactors using CP-3 and X-10 as examples. The examples include a calculation of the heating which results from the absorption of gamma-rays and of the chemical reaction which results from the absorption of gamma-rays. The nonuniformity of the gamma-ray dosage in bodies undergoing irradiation is demonstrated and estimated. The results show that in nuclear reactors the gamma-ray dosage varies very greatly depending on the experimental arrangements and that, in particular cases, the major contribution to the dosage can arise from any of the following individual sources or some combination of them: the material being irradiated, the containers, the structural members of the irradiation facility, the moderator, or the fuel. A.

539.166.7

6878. REFLECTION AND TRANSMISSION OF GAMMA RADIATION BY BARRIERS: MONTE CARLO CALCULATION BY A COLLISION-DENSITY METHOD. M.J.Berger.
J. Res. Nat. Bur. Stand., Vol. 55, No. 6, 343-50 (Dec., 1955).

The collision density of photons in an infinite Compton-scattering medium was calculated by random sampling. The intensity, spectral composition,and angular distribution were then determined for radiation reflected and transmitted by plane-parallel barriers by carrying out appropriate integrations over the collision density, taking into account the absorbing properties of the medium and the effect of boundaries. All numerical work was done on the National Bureau of Standards automatic computer (SEAC). Sample results are presented for 0.66 MeV radiation incident on water barriers of various thicknesses. A.

539.166.7

6879. REFLECTION AND TRANSMISSION OF GAMMA RADIATION BY BARRIERS: SEMIANALYTIC MONTE CARLO CALCULATION. M.J.Berger and J.Doggett.
J. Res. Nat. Bur. Stand., Vol. 56, No. 2, 89-98 (Feb., 1956).

The transport equation for photons which have been Compton-scattered repeatedly with a specified sequence of energy losses and deflections was solved analytically, by an "orders of scattering" approach, to obtain conditional reflection and transmission probabilities. These probabilities were then averaged over all possible intermediate angular and energy configurations in a Monte Carlo calculation carried out on the N.B.S. automatic computer (SEAC). The efficiency of the Monte Carlo calculation was increased by taking advantage of the close correlation between the transmission of radiation through thick barriers and the corresponding penetration problem in an infinite homogeneous medium for which an exact solution was available. The reflected and transmitted energy flux (integrated over all spectral energies and directions) has been calculated for 0.66, 1 and 4 MeV radiation incident on water barriers, and 1, 4 and 10 MeV radiation incident on iron tin, and lead barriers. Angular and energy spectra were obtained for water at 0.66 MeV. The ratio of the scattered energ flux, transmitted through a barrier to the scattered flux at equal depth in an infinite medium, was found to be constant for distances from the source greater than four mean free paths of the source radiation. A.

539.166.74/.75

6880. THE THEORY OF PROPAGATION OF GAMMA-RAYS THROUGH MATTER. V.I.Ogievetskiĭ.
Zh. éksper teor. Fiz., Vol. 29, No. 4 (10), 454-63 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 312-19 (March, 1956).

The angular and energy distribution of gamma radiation is found as a function of depth of penetration into matter, for an initial energy of the order of several MeV. A.

539.166.74/.75

6881. ANGULAR DISTRIBUTION OF GAMMA RAYS AT GREAT DEPTHS OF PENETRATION IN MATTER. V.I.Ogievetskiĭ.
Zh. éksper. teor. Fiz., Vol. 29, No. 4(10), 464-72 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 319-25 (March, 1956).

The angular and energy distribution of γ-rays at great depths of penetration in matter is found for the cases of constant and linear dependence of the absorption coefficient on wavelength. The passage of γ-rays through an inhomogeneous medium is examined. A.

539.166.74 : 537.533.8

6882. SCATTERING OF HIGH-ENERGY GAMMA RAYS. D.H.Green and E. C.Gregg.
J. appl. Phys., Vol. 27, No. 7, 697-8 (July, 1956).

The scattering of 16 MeV bremsstrahlung by 3, 6 and 9 in of iron was measured for small angles using a thallium-activated sodium-iodide scintillation counter. The experimental results closely fitted a theoretical curve calculated on the basis of single scattering. A.

539.166.74

6883. ELASTIC SCATTERING OF GAMMA RAYS. S.Messelt and A.Storruste.
Proc. Phys. Soc. A, Vol. 69, Pt 5, 381-7 (May, 1956).

When measuring elastic scattering of gamma rays, the secondary radiation from the scatterer, such as bremsstrahlung from photo- and Compton electrons and annihilation radiation, must be considered. It is shown that this secondary radiation is predominant in many experiments reported on elastic scattering of gamma rays. A measurement of the large-angle scattering of 1.33 MeV gamma rays by lead is described. It is found that the elastic scattering cross-section at 90° and 120° are, without corrections, 1.7×10^{-28} cm^2 per sterad and 1.6×10^{-28} cm^2 per sterad respectively. The first result is already below the combined effect of Rayleigh and Thomson scattering as calculated by Bethe, and both must contain contributions from bremsstrahlung etc. that can be

estimated only roughly but are appreciable. The present experiments therefore support the destructive interference of Dehlbrück scattering with the Rayleigh and Thomson components. A.

539.166.83

6884. ON THE CONVERSION-ELECTRON CORRELATION. F.Gimmi, E.Heer and P.Scherrer.
Helv. phys. Acta, Vol. 29, No. 2, 147-86 (1956). In German.

The conversion-electron correlation technique was investigated by measuring the γ-γ, γ-$e\bar{K}^-$, $e\bar{K}^-\gamma$- and $e\bar{K}^-e\bar{K}^-$-correlations of Cd^{111}. The results are found to be in good agreement with the theory of Biedenharn and Rose. A study of the $e\bar{K}$-γ-correlation in Hg^{197} led to an unambiguous choise between two possible decay schemes and indicated the spin of the ground state of Hg^{197} to be 1/2. Conversion-electron correlation experiments also provided an aid in determining the decay schemes of Hf^{181}—Ta^{181}. In both these cases, the e^--γ-correlation was found to be disturbed by a perturbation which was attributed to the interaction of the magnetic moment with the field of the excited electron shell. To correct the correlation function for the influence of the size of the source, new correction formulae have been calculated. A.

539.166.83

6885. STUDY OF THE SPECTRA OF CONVERSION ELECTRONS BY A β-SPECTROMETER MAKING USE OF THICK NUCLEAR EMULSIONS. I.A.Antonova.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 571-2 (1956). In Russian.

Problems of registering the electrons in plates are discussed; results for Cs^{137} are given by way of illustration. G.E.Brown

NUCLEAR REACTIONS 539.17

539.172

6886. THE CROSS-SECTION FOR THE ABSORPTION OF FAST PARTICLES BY SEMI-TRANSPARENT NUCLEI. S.I.Drozdov.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 3, 409-12 (1956). In Russian.

Uses a semi-classical approximation to the radial wavefunctions of angular momentum l for a complex potential well. The approximation is valid for $l \leq kR$, where R is the radius of the well. The method can also be used to treat the case in which there is a Coulomb interaction between the particle and the scatterer. J.M.Radcliffe

539.172

6887. A METHOD FOR MEASURING THE POLARIZATION OF NUCLEAR REACTION PRODUCTS. H.H.Barschall.
Helv. phys. Acta, Vol. 29, No. 2, 145-6 (1956).

A method is proposed in which the reverse reaction is used for analysis. A.

539.172 : 539.18 : 537.533.8

6888. INELASTIC DIFFRACTION PROCESSES AT HIGH ENERGIES. E.L.Feĭnberg.
Uspekhi fiz. Nauk, Vol. 58, No. 2, 193-230 (1956). In Russian.

Review of recent work of Landau, Ter-Mikaelyan, Pomeranchuk, Akhiezer, Migdal, Feĭnberg and Vdovin. The paper deals with electromagnetic processes in nuclear collisions (formation of a pair of π-mesons by γ-quanta, formation of electron-positron pairs), purely electromagnetic processes (bremsstrahlung effects), nuclear processes. Ten different effects are used to illustrate the peculiarities of diffraction processes arising from mutual interaction of particles. 38 refs. (mainly Russian). C.R.S.Manders

539.172

6889. ISOTOPIC INVARIANCE AND THE CROSS-SECTION FOR THE INTERACTION OF HIGH-ENERGY π-MESONS AND NUCLEONS WITH NUCLEONS. L.B.Okun' and I.Ya.Pomeranchuk.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 424 (1956). In Russian.

This note establishes some simple relations between cross-sections for scattering of nucleons and π-mesons which are valid at energies $\geq$ 1 BeV. The amplitudes for nucleon—nucleon scattering through states with T = 0 and T = 1 are approximately equal at these energies, as are the amplitudes for T = 3/2 and T = 1/2 in the case of meson—nucleon scattering. J.M.Radcliffe

539.172

6890. THEORY OF ASYMMETRICAL FISSION OF HEAVY NUCLEI. S.G.Rýzhanov.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 599-601 (1956). In Russian.

The picture proposed by Frenkel of fission as a tunnel effect through a potential barrier formed by the spherical nuclear well and Coulomb repulsion of the particles is found to explain many of the features of fission; in particular, the asymmetry of the fragments. G.E.Brown

539.172

6891. ANGULAR DISTRIBUTION OF FISSION FRAGMENTS. V.M.Strutinskiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 606-8 (1956). In Russian.

Qualitative features of the angular distribution in fission produced by fast neutrons, protons and gamma rays can be explained roughly by symmetry arguments and conservation laws. G.E.Brown

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172.13

6892. ANGULAR DISTRIBUTION OF DEUTERONS FROM $Be^9(p, d)Be^8$. II. J.Dąbrowski and J.Sawicki.
Acta phys. Polon., Vol. 14, No. 5, 407-18 (1955).

For Pt I, see Abstr. 9911 (1955). The formula for the Born approximation cross-section for the $Be^9(p, d)Be^8$ pickup reaction obtained with the help of the "Be^8 + neutron" model of the Be^9 nucleus is compared with the experimental data for 6.5 and 22 MeV protons. The best agreement is obtained for the Be^8-neutron square well, radius $r_0 = 5 \times 10^{-13}$ cm. The angular distributions for larger angles lie under the experimental curves mostly due to the compound state formation. The absolute values of the cross-section obtained by taking into account the Coulomb correction seem to be great because of the neglect of the Be^8-proton interaction. Comparison with the results of the Butler approximation determines the limits of validity of this approximation. The same model of the Be^9 nucleus is applied for the calculation of the Born cross-section for the $Be^9(d, t)Be^8$ reaction. The results are compared with experiment for 7.7 MeV deuterons. A.

539.172.13 : 539.164

ALPHA SPECTRUM IN THE $Li^7(p, \gamma)Be^{8*}(\alpha)He^4$ REACTION. See Abstr. 6117

539.172.13

6893. ELASTIC AND INELASTIC SCATTERING OF PROTONS FROM CARBON. H.Schneider.
Helv. phys. Acta, Vol. 29, No. 1, 55-74 (March, 1956). In German.

The angular distributions from these reactions were measured in the bombarding energy range 4.7-7 MeV. From an analysis of the data, the energy variations of the scattering phases are obtained, and the spin, parity and radiation widths of the levels deduced. The level scheme is compared with that for the mirror nucleus N^{13}. J.Hughes

539.172.13

6894. INTERACTION OF 10-MeV PROTONS WITH BERYLLIUM. S.W.Rasmussen.
Phys. Rev., Vol. 103, No. 1, 186-9 (July 1, 1956).

Differential elastic and inelastic scattering cross-sections were measured for 10 MeV protons on beryllium, using a nuclear-emulsion technique. The Minnesota linear proton accelerator was used to provide a well-collimated monoenergetic beam. The results for elastic scattering are compared with other experiments, on the basis of a simple optical model, although the variation of elastic scattering cross-section with angle is similar to that of other light elements, there are quantitative differences. The results on inelastic scattering are shown to be consistent with the currently accepted odd parity, $J = \frac{3}{2}$ or 5/2, for the 2.4 MeV state of Be^9. It appears, however, that a complex model of the Be^9 nucleus will be required to explain the results in detail. The (p, d) reaction cross-section for Be^9 is also mentioned briefly. A.

539.172.13

6895. ELASTIC SCATTERING OF PROTONS FROM B^{11} AND N^{14}. G.W.Tautfest and S.Rubin.
Phys. Rev., Vol. 103, No. 1, 196-9 (July 1, 1956).

The absolute differential cross-sections for the elastic scattering of protons by B^{11} and N^{14} have been measured with a probable error of 7%. The cross-section for $B^{11}(p, p)$ was measured at a centre-of-mass angle of 152° 36' for proton energies from 600 to 2000 keV. A marked scattering anomaly is observed at a proton energy of 675 (2^-) keV. The cross-section for $N^{14}(p, p)$ was measured at a centre-of-mass angle of 152° for proton energies from 850 to 1900 keV. Scattering anomalies were observed at proton energies 1.060 ($\frac{1}{2}^+$), 1.555 ($\frac{1}{2}^+$), 1.740 ($3/2^-$ or $5/2^-$) and 1.803 ($3/2^-$ or $5/2^-$) MeV. The indicated spin and parity assignments for the corresponding levels in the compound nucleus are consistent with the results of this experiment. The off-resonance cross-sections exhibit marked variations from the Rutherford cross-sections over the entire range of energies studied. A.

539.172.13

6896. DIRECT EXCITATION OF NUCLEAR ENERGY STATES IN CARBON BY 96-MeV PROTONS. K.Strauch and F.Titus.
Phys. Rev., Vol. 103, No. 1, 200-8 (July 1, 1956).

The scattering of 96 MeV protons from a carbon target has been investigated at laboratory argles between 3° and 90°. At the larger scattering angles, besides the elastic peak and inelastic continuum, inelastic peaks are found whose magnitude compares with the elastic peak. These inelastic proton peaks correspond to an excitation energy of the target nucleus of 4.4, 9.6 and 20.8 MeV. The angular distribution of elastically scattered protons shows slight diffraction minima at 40° and 64° (centre-of-mass) after a careful separation of elastic from inelastic protons is made. The inelastic protons are peaked in the forward direction. Possible interaction models are discussed. A.

539.172.13 : 539.18

6897. TOTAL p–p AND "p–n" CROSS SECTIONS AT COSMOTRON ENERGIES. F.F.Chen, C.P.Leavitt and A.M.Shapiro.
Phys. Rev., Vol. 103, No. 1, 211-25 (July 1, 1956).

The total proton–proton cross-section (excluding Coulomb scattering) has been measured at energies from 410 MeV up to 2.6 BeV, using external beams from the Cosmotron. Fast counting equipment was used to measure the attenuation of the beams through polyethylene, carbon and liquid H_2 absorbers. At each energy E, $\sigma_{p\text{-}p}(E, \Omega)$ was measured as a function of the solid angle Ω subtended by the rear counter at the centre of the absorber. The total cross-section $\sigma_{p\text{-}p}$ was obtained by a least squares straight line extrapolation to $\Omega = 0$. The measured $\sigma_{p\text{-}p}$ as a function of energy rises sharply from 26.5 mb at 410 MeV to 47.8 mb at 830 MeV and then remains approximately constant out to 1.4 BeV, above which energy it decreases gradually to about 42 mb at 2.6 BeV. Using the same equipment and procedure, the D_2O–H_2O difference cross-section, called "$\sigma_{p\text{-}n}$", was also measured for protons over the same energy range. From a comparison of "$\sigma_{p\text{-}n}$", and $\sigma_{p\text{-}p}$, with the n–p and n–d measurements of Coor et al. at 1.4 BeV, it is apparent that one nucleon is "shielded" by the other in the deuteron. This effect is not present at energies below 410 MeV. Comparing the measured p–p and "p–n" (corrected cross-sections with the results of other high-energy experiments, one may infer the following conclusions: (1) The sharp rise in $\sigma_{p\text{-}p}$ from 400 to 800 MeV results from increasing single pion production, which may proceed through the $T = \frac{3}{2}$, $J = \frac{3}{2}$ excited nucleon state. (2) Above 1 BeV the inelastic (meson production) p–p cross-section appears to be approximately saturated at 27-29 mb. (3) The rise in cross-section for n–p interaction in the T = 0 state, associated with the rise in double pion production, implies that double meson production also proceeds through the $T = \frac{3}{2}$ nucleon state. (4) The probable equality of $\sigma_{p\text{-}d}$ and $\sigma_{n\text{-}d}$ at 1.4 BeV implies the validity of charge symmetry at this energy. A.

539.172.13

6898. SPALLATION OF YTTRIUM BY 240-MeV PROTONS. A.A.Caretto, Jr and E.O.Wiig.
Phys. Rev., Vol. 103, No. 1, 236-9 (July 1, 1956).

The individual cross-sections of 36 nuclides resulting from the inelastic interaction of 240 MeV protons on yttrium were determined. The results were found to be in agreement with the current theories of high-energy nuclear reactions. By means of interpolated cross-sections for the stable nuclei produced in the reactions, it was possible to estimate the total inelastic cross-section for yttrium with 240 MeV protons. By use of this value and application of the optical model, r_0 for Y^{89} was found to 1.21×10^{-13} cm and the nuclear transparency about 17%. A.

539.172.13

6899. NEUTRONS FROM THE PROTON BOMBARDMENT OF B^{11}. F.Ajzenberg-Selove, G.D.Johnson, A.Rubin and M.Mazari.
Phys. Rev., Vol. 103, No. 2, 356-7 (July 15, 1956).

A thin target of isotopic boron has been bombarded with 7.03 MeV protons. The neutrons from the $B^{11}(p, n)C^{11}$ reaction, studied by means of nuclear emulsions, indicate an excited state of C^{11} at 2.01 ± 0.06 MeV. A.

539.172.13

6900. NONFISSION INELASTIC EVENTS IN URANIUM AND THORIUM INDUCED BY HIGH-ENERGY PROTONS. M.Lindner and R.N.Osborne.
Phys. Rev., Vol. 103, No. 2, 378-85 (July 15, 1956).

Activation cross-sections for about thirty products of high-energy proton-induced disintegration of U^{238} and Th^{232} have been measured by the radiochemical method. These products range from polonium (Z = 84) to neptunium (Z = 93). The energy dependence of some of these cross-sections has been determined for formation from U^{238}. Because of fission competition, the spallation cross-section of U^{238} is considerably less than that of Th^{232}. The data suggest that light isotopes of uranium are primarily responsible for the fission generally associated with high-energy particle bombardment of U^{238}. A.

539.172.13

6901. CROSS SECTION FOR $C^{12}(p, pn)C^{11}$. A.H.Rosenfeld, R.A.Swanson and S.D.Warshaw.
Phys. Rev., Vol. 103, No. 2, 413-19 (July 15, 1956).

The cross-section for the reaction C (p, pn)C has been measured at a proton energy of 461 MeV; the result is $\sigma =$ 31 mb with an associated error of 3%. Because of some disagreement among earlier experiments by several laboratories, a detailed discussion of the errors involved in those measurements is given, and in particular, a discussion of the techniques used for positron counting in a 4π proportional counter. A summary of the present state of knowledge of this reaction is presented. A.

539.172.13

6902. DISINTEGRATIONS PRODUCED IN THE LIGHT ELEMENTS OF NUCLEAR EMULSIONS BY 950 MeV PROTONS. R.McKeague.
Proc. Roy. Soc, A, Vol. 236, 104-11 (July 10, 1956).

Ilford G 5 photographic emulsions have been exposed to 950 MeV protons from the Birmingham synchrotron, and 430 m of proton track searched for nuclear disintegrations. Disintegrations of carbon, nitrogen and oxygen were selected by the potential barrier criterion; the adequacy of this method, which depends on the presence of a short α-particle track indicating the low Coulomb barrier of a disintegrating light nucleus, is discussed. The characteristics of the disintegrations occurring in the light nuclei are described and compared with those for heavy nuclei; most of the observed differences can be explained as features of the complete break-up of a nucleus consisting of a small number of nucleons. A.

539.172.13

6903. ELASTIC SCATTERING OF 5.4 MeV PROTONS BY VARIOUS NUCLEI. A.P.Klyucharev, L.I.Bolotin and V.A.Lutsik.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 573-4 (1956). In Russian.

Angular distributions are obtained for Be, C, F, Mg, Al, Ca, Mn, Ni, Cu and Zn. Protons are registered in photographic plates. G.E.Brown

539.172.13

6904. COMPOUND NUCLEUS EFFECTS IN DEUTERON REACTIONS: $C^{13}(d,p)C^{14}$. J.B.Marion and G.Weber.
Phys. Rev., Vol. 103, No. 1, 167-71 (July 1, 1956).

By using an angular distribution chamber with observation ports at 5^0 intervals from 5^0 to 165^0, the $C^{13}(d,p)C^{14}$ reaction has been studied as a function of the bombarding energy and angle of observation over the range of deuteron energy from 0.6 MeV to 3.0 MeV. A CsI crystal, with a resolution of 4.5% for the ground-state protons from C^{13} + d, was used as a detector. Excitation curves were obtained at angles of 20^0 and 135^0. A number of broad maxima were observed, the most pronounced effects occurring near $E_d \cong 1.4$ MeV. Twelve angular distributions were measured, at E_d = 0.64, 0.78, 0.87, 0.98, 1.23, 1.39, 1.48, 1.58, 1.74, 1.99, 2.36 and 2.84 MeV. Those distributions obtained below 1.5 MeV are well described by a power series expansion in $\cos\theta$, involving terms up to $\cos^4\theta$. The variation with energy of the angular distributions suggest that for these low bombarding energies the major part of the cross-section is probably due to compound nucleus formation. For energies above 1.7, a maximum in the distributions occurs near $\theta \cong 25^0$. This peak becomes more pronounced at the higher energies and indicates that for $E_d \gtrsim 1.7$ MeV, the stripping process becomes increasingly important. A.

539.172.3

6905. FORM OF THE SPECTRUM OF PHOTOPROTONS FROM THE REACTION Cu (γ,p) Ni, OBTAINED WITH THE AID OF MONOCHROMATIC γ-RAYS. R.Chastel.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2337-40 (May 7, 1956). In French.

The spectrum produced by 14.8 and 17.6 MeV incident γ-rays has been measured, using nuclear emulsion detectors. Comparison with evaporation theory indicates an excess (between 3 and 9%) of high-energy protons due to the direct photonuclear effect. J.J.Wilkins

539.172.3

6906. ON THE RESONANT ABSORPTION OF PHOTONS IN CARBON. C.Tzara.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2340-3 (May 7, 1956). In French.

Activation curves for the (γ, n) reaction have been measured simultaneously for two carbon targets separated by a carbon absorber. The ratio of the target activities gives a width $\Gamma_n > 580$ keV for the absorption resonance at 22.8 MeV photon energy. This disagrees with the value $\Gamma < 40$ keV derived in the usual way from the form of a single activation curve. J.J.Wilkins

539.172.3

6907. THE PHOTONEUTRON YIELDS FROM ^{208}Pb. J.D.Prentice and K.G.McNeill.
Phil. Mag. (Ser. 8), Vol. 1, No. 4, 373-4 (April, 1956).

Measurements of total photoneutron yields have been made, using 22 MeV incident bremsstrahlung and a large NaI crystal detector. The reported ratio of yields from Pb^{208} and ordinary lead is 1.15 ± 0.24. About 0.025 of the Pb^{208} events lead to the 0.8 sec state of Pb^{207}. J.J.Wilkins

539.172.4

6908. EFFECTS OF NONDEGENERACY OF NUCLEAR GROUND STATE ON LOW-ENERGY NEUTRON REACTIONS. K.A.Brueckner.
Phys. Rev., Vol. 103, No. 1, 172-81 (July 1, 1956).

The imaginary part of the potential acting on a neutron moving in the nucleus is shown to be very sensitive to the departure of the nuclear ground-state wave function from that of an independent-particle model. The nucleon–nucleon interaction which gives rise to the neutron absorption also leads to correlation structure in the nuclear wave function. This manifests itself both in the partial emptying of the independent-particle states near the Fermi momentum and in the velocity dependence of the real part of the average potential seen by the neutron. These effects are determined by using interaction operators derived in studies of the nuclear saturation problem. The result is that the velocity dependence of the potential reduces V_{Im} by a factor of about eight; the departure of the nuclear state from complete degeneracy gives an increase of roughly 5 in the opposite direction. Thus, the two effects nearly cancel so that the final prediction for V_{Im} at a density corresponding to $R = 1.40 \times 10^{-13} A^{1/3}$ cm is close to the empirical value. It is also found that V_{Im} decreases rapidly for higher nuclear densities, suggesting that the neutron absorption may be primarily a surface phenomenon. A.

539.172.4

6909. $B^{10}(n, t2\alpha)$ AND $B^{10}(n, dn'2\alpha)$ REACTIONS FOR 6-20 MeV NEUTRONS. G.M.Frye, Jr and J.H.Gammel.
Phys. Rev., Vol. 103, No. 2, 328-34 (July 15, 1956).

In a set of B^{10}-loaded C-2 emulsions exposed to eight neutron energies in the range 6-20 MeV, 1541 three-prong stars were found which were caused by either the $B^{10}(n, t2\alpha)$ or the $B^{10}(n, dn'2\alpha)$ reaction. The triton cross-section at 14 MeV is 102 ± 17 mb and decreases with increasing bombarding energy, while the deuteron cross-section is 128 ± 19 mb and increases slightly with energy. The triton reaction proceeds partially through the 4.61 MeV state in Li^7 and partially as a three-body breakup. In the deuteron reaction the following intermediate nuclei are formed: Be^9, 2.43 MeV state; Be^8, ground state and possibly the 2.9 MeV level; Li^7, 10.8 and 12.4 MeV levels; and Li^6, 2.19 MeV level. Four examples were found of the $N^{14}(n, t3\alpha)$ reaction. The feasibility of using the $B^{10}(n, t2\alpha)$ reaction as a neutron monitor is discussed. A.

539.172.4

6910. REACTION $B^{11}(n, \alpha)Li^8(\beta^-)Be^{8*}(2\alpha)$ FOR 12- TO 20-MeV NEUTRONS. A.H.Armstrong and G.M.Frye, Jr.
Phys. Rev., Vol. 103, No. 2, 335-48 (July 15, 1956).

Ilford 200-μ C-2 plates loaded with B^{11} were exposed to monoenergetic neutrons produced at nine angles to a 3.5 MeV deuteron beam incident upon a tritium gas target. Measurements of range and space angles were made upon 450 "hammer stars" which were found to result from the $B^{11}(n, \alpha)Li^8(\beta^-)Be^{8*}(2\alpha)$ reaction. The cross-sections in mb as a function of energy in MeV are as follows: 12.6 MeV, 27.0 ± 6.5 mb; 13.0, 38.4 ± 7.4; 14.7, 30.9 ± 6.3; 15.4, 36.9 ± 7.0; 16.9, 21.9 ± 3.6; 17.6, 23.7 ± 4.8; 18.9, 19.7 ± 3.7; 19.8, 16.3 ± 3.1; 20.0, 15.8 ± 3.1. The angular distribution of the alpha-particles from the (n, α)

reaction is obtained at each energy. In nearly all cases the Li^8 is left in the ground state or in the first excited state of 1 MeV. The Be^8 disintegration goes through the broad 3 MeV level and possibly a lower level near 2 MeV. A range–energy relation is found for Li^8 in Ilford C-2 emulsion. Comparison with previous experimental results shows closest agreement with Barkas. A.

539.172.4

6911. NEUTRON SCATTERING AT 2.45 MeV BY A TIME-OF-FLIGHT METHOD. L.Cranberg and J.S.Levin.
Phys. Rev., Vol. 103, No. 2, 343-52 (July 15, 1956).

Results have been obtained by a pulsed-beam time-of-flight method for the cross-sections for excitation of various levels in many nuclides by inelastic scattering at 90 degrees. The incident neutrons had a mean energy of 2.45 MeV and a spread of plus and minus 100 keV. Detailed angular distributions are given for the neutrons of inelastic scattering, for the accompanying de-excitation gamma-rays, and for the elastically scattered neutrons for iron, nickel and titanium. Such results are also given for iron and titanium for a mean incident energy of 2.25 MeV. The angular distributions indicate that for these nuclides and excitations the statistical assumption is not applicable to states in the compound nucleus. results on the spectrum of neutrons inelastically scattered by gold may be fitted over a limited range by an effective nuclear temperature of 0.3 ± 0.03 MeV. The same temperature describes the data on uranium 238 after subtraction of a fission neutron spectrum. A.

539.172.4

6912. NEUTRON INELASTIC CROSS-SECTIONS BETWEEN 55 AND 140 MeV. R.G.P.Voss and R.Wilson.
Proc. Roy. Soc. A, Vol. 236, 41-51 (July 10, 1956).

The neutron inelastic cross-sections for lead, cadmium, copper, aluminium and carbon have been measured at 140, 105, 81 and 55 MeV, by using a large liquid scintillation counter in a bad-geometry experiment. At the lower energies the cross-sections decrease monotonically with increase in energy, but thereafter remain practically constant as the energy is increased. A.

539.172.4

6913. THE ANALYSIS OF HIGH-ENERGY NEUTRON CROSS-SECTIONS. R.G.P.Voss and R.Wilson.
Proc. Roy. Soc. A, Vol. 236, 52-67 (July 10, 1956).

The neutron inelastic cross-sections reported in the preceding abstract are interpreted in terms of the square-well and harmonic oscillator optical models, and also the tapered density distribution. Neutron and proton inelastic cross-sections are compared, and are shown to suggest that the neutrons in a nucleus have a larger spatial distribution than the protons. Finally, neutron total cross-sections are used to put an upper limit to the permissible surface thickness of a nucleus. A.

539.172.4

6914. INELASTIC SCATTERING OF NEUTRONS BY ROTATIONAL EXCITATION. S.Hayakawa and S.Yoshida.
Progr. theor. Phys., Vol. 14, No. 1, 1-15 (July, 1955).

The collective nuclear model of A.Bohr is applied to the interpretation of inelastic scattering of neutrons, as was briefly described in the previous report (see Abstr. 9906/1955). The present paper deals with the detailed theory of the inelastic scattering of neutrons by a direct excitation of the nuclear surface rotation, as well as by the resonance scattering via compound nuclei. The cross-section for the former process is proportional to the square of the intrinsic quadrupole moment and depends strongly upon the amplitudes of the neutron waves at the nuclear surface. This strong dependence makes it difficult to compare the proposed theory with experiments. Conversely the strong dependence may be employed to find the optical potential which distorts the neutron waves. It is pointed out that the contributions from the direct and compound nucleus forming processes can be distinguished by observing the angular distribution. A.

539.172.4

6915. THE Cu (n, 2n) EXCITATION FUNCTION AND THE KNOCK-OUT PROCESS IN NUCLEAR REACTIONS.
R.Nakasima and K.Kikuchi.
Progr. theor. Phys., Vol. 14, No. 2, 126-34 (Aug., 1955).

The (n, 2n) excitation cross-section in copper is calculated on the basis of the compound nucleus formalism. If the probability for the formation of the compound nucleus by the incident neutron is assumed to be equal to unity, the calculated cross-section becomes much larger than the experimental one. When the knock-out process is taken into account and a smaller probability is adopted, the agreement with the experiment can be somewhat improved. The estimate of the cross-section of the knock-out process is obtained by the use of a very simplified model. A.

539.172.4

6916. NEUTRON–NUCLEUS INTERACTION CROSS-SECTIONS. P.É.Nemirovskiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 551-9 (1956). In Russian.

A new quasi-classical solution of the Schrödinger equation for $E > |V|$ is presented. The approximation may be used to solve the problem of the motion of a neutron in a field with a complex potential. The variation of the total cross-sections at energies 20-100 MeV is explained. The Schrödinger equation with a complex potential, which tends exponentially to zero at infinity, has been solved for energies of 2-10 MeV. It is shown that in distinction from the absorption cross-section for a rectangular well, the absorption cross-section for a well with a smeared-out edge does not possess any sharp maxima depending on R or E. The agreement between the absorption cross-section computed for E = 2.5 MeV and 4.3 MeV, and the experimental data is satisfactory. A.

539.172.4

6917. MASS SPECTROMETRICALLY DETERMINED INDEPENDENT YIELDS OF I^{128}, I^{130}, Br^{80}, AND Br^{82} FOR U^{233}, U^{235}, AND Pu^{239} FISSION. T.J.Kennett and H.G.Thode.
Phys. Rev., Vol. 103, No. 2, 323-7 (July 15, 1956).

The primary yields of the shielded nuclei I^{128} and I^{130} have been accurately determined for the thermal neutron fission of U^{233}, U^{235}, and Pu^{239}. This has been done by the measurement of their stable daughterd Xe^{128} and Xe^{130} using sensitive mass spectrometric techniques. The values of these primary yields show marked deviations from those predicted by the present theories of charge distribution. This discrepancy can be explained if the effect of the 50 proton shell is taken into account in the evaluation of the most probable initial nuclear charge Z_p for mass numbers 128 and 130. This can be done by postulating a most probable charge which will yield the greatest energy release in the fission process. Also the primary yields of Br^{80} and Br^{82} were determined by means of their daughters Kr^{80} and Kr^{82} for the thermal fission of U^{233} and U^{235} and for the fast fission of Pu^{239}. The yields of these nuclei for fast neutron fission were ~ 100 times those for thermal fission, indicating a shift in the charge distribution curve with neutron energy. A.

539.172.4

6918. TWO-GROUP DIFFUSION IN SLAB LATTICE REACTORS. F.B.Estabrook.
J. appl. Phys., Vol. 27, No. 2, 175-8 (Feb., 1956).

Criticality calculations for heterogeneous reactor media are usually based on a single-cell calculation of f, the thermal utilization, followed by a "homogenized" treatment of the macroscopic neutron migration. A changed approach is here advocated, in which diffusion theory is applied only to the multiply-connected moderator portions of the reactor, the

uel is treated by the use of multiplying boundary conditions, nd no arbitrary averaging need be done. As an example, the ne-dimensional case of plane fuel slabs in moderator is treat-d, and the material buckling characteristic of the fundamen-al mode is obtained using two-group theory. The equation for his case readily allows a comparison between neutron migra-ion lengths parallel to and perpendicular to the fuel slabs: considerable anistropy is found, in magnitude greatly depend-nt on fuel slab separation. A.

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6919. OBSERVATION OF ELECTRON SECONDARIES FROM V^0 DECAYS. M.M.Block, E.M.Harth, M.E.Blevins nd G.G.Slaughter.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 46-50 (July, 1956).

Three examples of V^0 particles having electron second-aries have been observed in a cloud chamber exposed to a 1.9 GeV π^- beam from the Cosmotron. The experimental evidence is suggestive of the decay scheme, $K^0_{e3} \rightarrow \tau^{\pm} + e^{\mp} + \nu$. A.

539.18

6920. CLOUD CHAMBER OBSERVATIONS OF NEGATIVE HEAVY MESONS. E.G.Michaelis and B.W.Powell.
Phil. Mag. (Ser. 8), Vol. 1, No. 5, 441-9 (May, 1956).

Earlier work by the Manchester Jungfraujoch group on slow, negative, heavy cosmic-ray particles observed in a magnet cloud chamber has been repeated. An upper limit to the frequency of slow K^--mesons which do not decay in the cloud chamber is now found to be $\sim 1\%$ of the frequency of slow protons. From other published data the probable ratio of the two frequencies is estimated as about 1 : 2000. The identity of the observed particles is discussed. The previous results giving a high frequency and a long mean lifetime for K^--mesons are not confirmed. One event showing the possible simultaneous production of two slow K^--mesons and one example of an upward-moving S^+-particle are described. A.

539.18

6921. TWO HYPERFRAGMENTS FROM NEGATIVE K-PARTICLE CAPTURE AND THE MASS OF THE NEGATIVE K PARTICLE. F.C.Gilbert, C.E.Violet and R.S.White.
Phys. Rev., Vol. 103, No. 1, 248-9 (July 1, 1956).

Two hyperfragments are described which have been found from 81 negative K-particle interactions at rest and in flight. Event 35 was identified as a K^- capture in carbon which emitted a ${}_{\Lambda}Li^7$ hyperfragment that decayed into a π^- meson and a Be^7 fragment. The binding energy of the Λ hyperon in ${}_{\Lambda}Li^7$ was found to be 4.4 ± 0.7 MeV. The mass of the negative K particle which was captured in this reaction was found to be 966.2 ± 5.0 electron masses. In Event 71, a negative K particle was captured in a light nucleus. Four charged particles and a π^- meson and a hyperfragment, ${}_{\Lambda}He^4$, left the K^- ending. The ${}_{\Lambda}He^4$ decayed into a proton, a π^- meson, and a He^3 fragment. The binding energy of the Λ hyperon in ${}_{\Lambda}He^4$ was found to be 1.5 ± 0.6 MeV. A.

539.18

6922. EXCLUSION PRINCIPLE INHIBITION OF BOUND HYPERON MESONIC DECAY. H.Primakoff.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1394-9 (June, 1956).

An explanation is given of the variation with A, Z, of (1) the ratio of the probabilities of mesonic to non-mesonic decay of hyperfragments and (2) the mean life of the hyperfragments. The explanation involves an exclusion principle inhibition of the bound hyperon mesonic decay. Some evidence is presented in favour of a Λ^0 hyperon spin and parity (relative to a nucleon) of $\frac{1}{2}^-$ (or less probably, of $\frac{1}{2}^+$ or $\frac{3}{2}^+$) $(^+)$. A.

539.18

6923. THE DEPENDENCE OF THE COMPOSITE MEAN LIFE OF MU-MESONS ON THE ATOMIC NUMBER OF THE ABSORBER. N.N.Biswas.
Indian J. Phys., Vol. 29, No. 11, 527-33 (Nov., 1955).

The measurements of the mean life of the composite beam of μ-mesons (both positive and negative) at sea level in the absorbers of C, Al, S and Pb have been reported previously. The same experiment has been conducted with water and NaF absorbers. In water (only oxygen is effective, since a hydrogen atom rarely captures a μ-meson), the composite mean life is found to be 1.95 ± 0.08 μsec. Choosing the thickness of water absorber to be equivalent to the sulphur absorber in respect to the stopping power of the μ-mesons, the decay curve of the positives in S has been taken to represent the same in water, and hence, by subtraction, the mean life of the negative μ-mesons in water has been determined to be equal to 1.80 ± 0.19 μsec. In the case of NaF ($Z_{eff} = 10.1$) absorber, the experimental points have been found to represent a composite decay curve giving the mean life equal to 1.82 ± 0.09 μsec. The Z-dependence of the composite mean life has been found to fit an empirical relation, $\tau_{\pm} = 2.50 - 0.065\ Z$ μsec, in the interval Z = 6 to Z = 16.

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6924. MASS AND SPIN-PARITY CHARACTER OF THE τ-MESON. H.H.Heckman, F.M.Smith and W.H.Barkas.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 51-8 (July, 1956).

Analyses of 41 τ- and τ'-meson decay events are presented. Since the emulsion density was accurately known, and an improved range-energy curve is available, a Q-value for the τ-decay was obtained which is more precise than that available heretofore. It is 75.08 ± 0.20 MeV. Analysis to determine the character of the τ-meson was made by comparing the experimental data with the 5 spin-parity combinations that lead to unique energy and angular distributions. It is found on employing a χ^2 test that there is a probability of 18% that the χ^2 for the $(0, -)$ choice may exceed that observed, whereas the next most probable choice, $(3, -)$, yields a probability of only 2.8%. The data could not distinguish between the $(0, -)$ and $(2, -)$ states of the τ-meson. The τ'/τ ratio observed is 0.25 ± 0.12, which is consistent with the hypothesis of charge independence. The energy distribution of the π^+-meson in the τ'-decay is consistent with the decay scheme $\tau' \rightarrow \pi^+ + 2\pi^0$, and an associated electron pair also confirms this supposed mode of decay. A.

539.18

6925. MASS OF THE Σ^+ HYPERON. W.F.Fry, J.Schneps, G.A.Snow and M.S.Swami.
Phys. Rev., Vol. 103, No. 1, 226-7 (July 1, 1956).

Ten examples of the protonic decay from rest of the Σ^+ hyperon have been analysed. The ranges of the protons from the Σ^+ decays were corrected for variations in the stopping power of each emulsion batch by determining the mean range of μ-mesons from $\pi-\mu$ decays. The mean range of the protons, after correcting for variations in stopping power, was found to be 1669 ± 8.0 microns. The r.m.s. deviation of the proton ranges was found to be 38.5 ± 8.0 microns. The Q of the Σ^+ decay, $\Sigma^+ \rightarrow p + \pi^0$ is 116.1 ± 0.5 MeV, and the mass of the Σ^+ hyperon is $(2327.4 \pm 1.0)m_e$. A.

539.18

6926. ON BOUND Λ^0 PARTICLES. K.Ono.
Progr. theor. Phys., Vol. 13, No. 5, 522-8 (May, 1955).

Discusses the possibility of explaining the binding of Λ^0 particles in nuclear fragments in terms of the interaction which produces the reaction $p + \pi^- \rightarrow \Lambda^0 + \theta^0$. The binding energy of a Λ^0 in an infinitely large nucleus is found to be about 2.3 MeV, while, for the fragments of a finite radius, the lower limit of the mass number A for binding a Λ^0 is found to be $A^{1/3} > 2.9$. A.

539.18

6927. SOME REMARKS ON THE REACTION $K^- + d \rightleftarrows \Sigma^- + p$. K.Nishijima.
Progr. theor. Phys., Vol. 14, No. 6, 523-6 (Dec., 1955).

Recently Lee has suggested that the reaction $K^- + d \rightleftarrows \Sigma^- + p$ might lend itself to a determination of the spins of the negative K meson and negative Σ particle. Because of the degeneracy of the mass levels of heavy mesons, however, the application of the detailed balancing arguments is not so simple as was the case with the positive pion unless heavy mesons with different names represent the competing modes of decay of a single kind of heavy mesons. In this paper, a possible experimental method is proposed to determine the spins of the negative K meson and negative Σ particle from the observation of the process $K^- + d \rightleftarrows \Sigma^- + p$ by using a K meson beam which is in general a mixture of distinct kinds of K mesons. A.

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6928. SPURIOUS SCATTERING IN NUCLEAR EMULSIONS. F.A.Brisbout, C.Dahanayake, A.Engler, P.H.Fowler and P.B.Jones.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1400-10 (June, 1956).

Spurious scattering has been investigated in three stacks of stripped emulsions; one of these has been exposed to the 4.5 GeV π-meson beam at Berkeley, the other two to cosmic radiation. Multiple scattering measurements performed on flat tracks of high energy particles show that the spurious scattering in two of these stacks is appreciably smaller than that obtained by Biswas et al., Lohrmann and Teucher, and Fay and that reliable measurements up to 5 GeV (for singly charged particles) can be made using a basic cell size of one mm. Clearly spurious scattering is a function of the quality of the stack. A procedure for eliminating spurious scattering is suggested which in particular cases permits measurements to be extended to higher energy regions. A.

539.18

6929. INTERACTION OF 1.4 BeV PIONS WITH PROTONS. A.I.Nikishov.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 601-3 (1956). In Russian.

The various end products and the final nucleon momenta are calculated using the statistical theory including the isobar state, and are compared with experiment and with the results of the Fermi theory, which does not include the isobar. G.E.Brown

539.18

6930. MUONIC INTERACTIONS IN DENSE MATERIAL. M.M.Biswas.
Indian J. Phys., Vol. 29, No. 10, 490-500 (Oct., 1955).

Production of associated penetrating particles (A.P.P.) and groups of penetrating particles (G.P.P.) by fast μ-mesons interacting with lead placed above a cloud chamber and the star formation in the lead plate inside the chamber have been investigated. The cross-section for the formation of A.P.P. and G.P.P. comes out to be of the order of $\sim 10^{-30}$ cm^2/nucleon and that for star formation $\sim 10^{-29}$ cm^2/nucleon which are in agreement with the observations of other authors. A.

539.18

6931. ON THE INTERACTION BETWEEN HYPERONS AND NUCLEONS AND THE HYPERFRAGMENTS. K.Nishijima.
Progr. theor. Phys., Vol. 14, No. 6, 527-34 (Dec., 1955).

Based on the principle of charge independence and the experimentally established evidence for the existence of the hyperfragment H^{3*}, the nature of the force between a Λ^0 particle and a nucleon is investigated. It is shown that the range of the Λ–nucleon force cannot be longer than half the pion Compton wavelength and that its well depth parameter is larger than about 0.4. This result suggests us the possible existence of the so-called hyper di-nucleons. Next, the mechanism of the non-mesonic decays of a hyperfragment He^{4*} is investigated. A qualitative argument leads to the conclusion that the spin of the Λ^0 particle cannot be larger than 3/2. A

539.18

6932. DEDUCTION OF RELATIONSHIPS AMONG CROSS-SECTIONS BASED ON THE HYPOTHESIS OF ISOTOPIC INVARIANCE. I.Shmushkevich.
Dokl. Akad Nauk SSSR, Vol. 103, No. 2, 235-8 (1955). In Russian.

A simple method for obtaining these relationships is given and illustrated by the following examples: (1) scattering of π-mesons (π^+, π^- and π^0) on nucleons (n and p); (2) formation of one π-meson in nucleon–nucleon collisions; (3) formation of two π-mesons in nucleon–deuteron collisions; (4) annihilation of nucleon–antinucleon pairs with formation of two π-mesons and (5) three π-mesons.

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6933. DEDUCTION OF RELATIONSHIPS AMONG CROSS-SECTIONS BASED ON THE HYPOTHESIS OF ISOTOPIC INVARIANCE. N.Dushin and I.Shmushkevich.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 5, 801-4 (1956). In Russian.

In a previous paper (see preceding abstract) a simple method for obtaining relationships among cross-sections based on the hypothesis of the isotopic invariance, has been deduced. In some cases, however, their actual number is larger than that obtained by the above method. In the present paper it is shown with the help of a few examples (collisions of π-mesons with nucleons, scattering of π-mesons by deutero pair formation of π-mesons in π + d reactions, decay of τ-mesons into three π-mesons) how a slight modification of the established procedure may give the full set of required relationships. G.Martelli

539.18

6934. ON RELATIONS BETWEEN THE CROSS-SECTIONS FOR MULTIPLE PRODUCTION OF π-MESONS. N.V.Dushin.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 6, 977-80 (1956). In Russian.

Uses conservation of isotopic spin to deduce some relations between the total cross-sections for production of two π-mesons in (π, p), (π, d) and (p, n or p) collisions. More restrictive relations between the differential cross-sections which are valid at threshold, or more generally when both outgoing mesons have the same momentum, are obtained by taking account of the symmetry required in the space part of the mesons' wavefunction. J.M.Radcliffe

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6935. ON THE PRODUCTION OF HEAVY MESONS IN THE NUCLEON-NUCLEON COLLISIONS AT ENERGIES NEAR THE THRESHOLD. P.Brovetto and S.Ferroni.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1387-93 (June, 1956).

Calculations based on the statistical theory are made for the production of pions and heavy mesons in nucleon–nucleon collision energies below 10 GeV in the laboratory system. Multiplicities are derived as functions of energy, and the energy spectra for the various kinds of particles are given. Average multiplicities as a function of the energy spectrum of the proton component in cosmic radiation are also given. A.

539.18

6936. THE PHOTOPRODUCTION OF CHARGED MESONS FROM CALCIUM. W.R.Hogg and D.Sinclair.
Phil. Mag. (Ser. 8), Vol. 1, No. 5, 466-72 (May, 1956).

The yields of π^- and π^+ mesons from calcium have been measured at 90° to a photon beam with a maximum energy of 330 ± 10 MeV. The mesons were detected in nuclear emulsions. The ratio of the numbers of π^- to π^+ mesons was determined to be 0.56 ± 0.18 at a pion energy of 80 MeV. Above 95 MeV the ratio fell rapidly to 0.39 ± 0.12 at 112 MeV. Approximate values for the cross-sections for the production of π^+ and π^-

esons, as a function of pion energy, were also determined. he experimental results may be given a semiquantitative xplanation by the theory of Butler (1952). A.

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937. PRODUCTION OF A θ^0 PARTICLE WITHOUT AN SSOCIATED HYPERON IN A π^-–p COLLISION. W.B.Fowler, .Maenchen, W.M.Powell, G.Saphir and R.W.Wright. hys. Rev., Vol. 103, No. 1, 208-10 (July 1, 1956).

An event is described that is interpreted as evidence for e simultaneous production of a θ^0 and a $\bar{\theta}^0$ according to the cheme of Gell-Mann and Pais. This interpretation assumes e production of a normal θ^0 and a K^0 with no associated yperon, where the θ^0 is observed and the K^0 is inferred from e rule of associated production of heavy unstable particles. he event was obtained by exposing a high pressure diffusion loud chamber to a 4.5 BeV/c π^- meson beam from the Beva-on. The event is most reasonably interpreted as $\pi^- + p \rightarrow \pi^- p + \theta^0 +$ (neutral). Energy and momentum conservation are atisfied by an undetected neutral particle having a mass of 02_{-124}^{+91} MeV. This is consistent with the associated produc-on of a θ^0 and a $\bar{\theta}^0$ according to the scheme of Gell-Mann and ais. Details are given and alternative interpretations are iscussed. A.

539.18

938. ON THE ANGULAR DISTRIBUTION OF DOUBLE ION PRODUCTION IN PION–NUCLEON COLLISIONS AT .4 BeV. D.Itô and S.Minami. rogr. theor. Phys., Vol. 14, No. 5, 482-6 (Nov., 1955).

An angular distribution of the doubly produced pions in ion–nucleon collisions at 1.4 BeV is analysed with the aid of hase space consideration, making some simple assumptions n the transition matrix elements of the processes. A.

539.18

939. SELECTION RULES FOR N$\bar{\text{N}}$ ANNIHILATION. .Goebel hys. Rev., Vol. 103, No. 1, 258-61 (July 1, 1956).

Selection rules governing the annihilation of a nucleon–ntinucleon pair into pions, photons and heavy mesons are erived from the conservation of angular momentum, parity, harge parity and isotopic spin. Special attention is given to he probability of annihilation purely into neutral pions. A.

539.18

6940. ANNIHILATION OF ANTINUCLEONS WITH STAR PRODUCTION. S.Z.Belen'kiĭ and I.L.Rozental'. Zh. éksper. teor. Fiz., Vol. 30, No. 3, 595-6 (1956). In Russian.

Using Fermi's statistical theory, the mean number of mesons arising in the annihilation is calculated and found to be ~4. G.E.Brown

539.185

6941. ABSOLUTE CALIBRATION OF THE NATIONAL BUREAU OF STANDARDS PHOTONEUTRON STANDARD. II. ABSORPTION IN MANGANESE SULFATE. J.De Juren and J.Chin. J. Res. Nat. Bur. Stand., Vol. 55, No. 6, 311-16 (Dec., 1955).

For Pt I, see Abstr. 4023 (1956). An absolute method of calibrating a neutron source by determining the neutron absorption rate in a manganese sulphate bath is described. In this method slightly more than one litre of solution from the bath is irradiated in a strong neutron flux. The absolute activity of manganese in an aliquot of this activated solution is determined with a 4π flow proportional counter. Concurrently, one litre of this solution is added to the inactive bath and after stirring, the counting rate is measured with a dip counter. As the number of radioactive manganese nuclei contained in the litre is obtained from the aliquot activity, the dip counter is calibrated for a known manganese activity. Then the bath is irradiated by the source and the dip counting rate at saturation yields the neutron capture rate by the manganese. From a knowledge of the neutron capture cross-sections and the manganese sulphate concentration, the fraction of neutrons captured by manganese is determined. As a result, the total neutron capture rate in the bath at saturation is obtained. A value of $Q = 1.25_0 \times 10^6$ neutrons per second was obtained for the National Bureau of Standards source (1954). The standard error is ± 2%. A.

539.185

6942. THE DIFFUSION PARAMETERS OF THERMAL NEUTRONS IN WATER. A.Bracci and C.Coceva. Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 59-66 (July, 1956).

The neutrons are produced with a pulsed source using d+d reaction and slowed down and diffused in cylindrical tanks of different shape filled with distilled water. Neutron detectors situated on the surface of the tanks and connected with an eighty channel time analyser give a measure of the neutron flux as a function of time. Results obtained for the lifetime of neutrons in water and for the collision mean free path are discussed and compared with the known values. A.

539.185

6943. A NEW METHOD OF MEASURING ASYMMETRIES IN NEUTRON POLARIZATION EXPERIMENTS. P.Hillman, G.H.Stafford and C.Whitehead. Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 67-74 (July, 1956).

A solenoid has been constructed 11 feet in length and with a maximum rating of 1.14×10^6 ampere turns which enables the plane of polarization of a neutron beam to be turned through 90° in either direction. This enables asymmetry measurements to be made in neutron polarization experiments without moving the detecting apparatus. This is a great advantage in experiments in which polarization effects are small and false asymmetries, which can be introduced when the detector is moved, correspondingly very difficult to eliminate with sufficient accuracy. The method has been tested by using the partially polarized neutron beam produced with a beryllium target in the Harwell cyclotron. Asymmetry measurements were made by counting neutrons scattered at an angle of $\frac{1}{2}^0$ off a uranium scatterer. Four values of the solenoid current were used and the results obtained agree well with those expected theoretically. A.

539.185

6944. THE ELECTRIC CHARGE OF THE NEUTRON. I.S.Shapiro and I.V.Éstulin. Zh. éksper. teor. Fiz., Vol. 30, No. 3, 579-80 (1956). In Russian.

An attempt to observe the deflection of a neutron beam in an electric field shows no effect and puts an upper limit on the neutron charge of 6×10^{-12} of the electron charge. G.E.Brown

539.185 : 537.12/.13

ISOTOPIC INVARIANCE AND THE SCATTERING OF ANTINUCLEONS BY NUCLEONS. See Abstr. 5829

STRUCTURE OF SOLIDS 539.2

539.21

6945. ON THE NATURE OF THERMAL SPIKES. C.W.Tucker, Jr and P.Senio. J. appl. Phys., Vol. 27, No. 3, 207-9 (March, 1956).

Theoretical calculations suggest that the duration (10^{-11} sec) and smallest dimension (20 atom diameters) of thermal spikes in metals undergoing irradiation may be too small to permit the thermal nucleation and growth of crystals of a second phase even though the average "temperature" of the spike may be above the melting point. Experiments have been performed which show that even the very energetic

fission thermal spikes are too rapid and small to permit the nucleation and growth of a second phase in uranium metal containing 2 atomic % chromium. It is suggested that the terms "heated" and "melted" are not strictly appropriate to thermal spikes. Rather the region of a thermal spike should be regarded as a highly disturbed zone in which atomic interchange can occur, but which quickly returns to the structure and orientation of the surrounding crystal with a distribution of interstitials and vacancies which may then interact with each other or with other defects possibly present in the crystal. A.

539.21 : 536.424.1 : 539.89

6946. POLYMORPHISM OF IRON AT HIGH PRESSURE. D.Bancroft, E.L.Peterson and S.Minshall.
J. appl. Phys., Vol. 27, No. 3, 291-8 (March, 1956).

Propagation of compressive waves generated by high explosives in Armco iron may, under certain conditions, occur with three stable shocks, which are characterized by abrupt and possibly quasi-discontinuous change of pressure. The characteristics of these have been investigated experimentally and found to be consistent with the hypothesis of a polymorphic transition in iron at about 0.13 megabar. The same phenomenon has been observed in mild steel. A.

539.21

6947. EFFECT OF FAST NEUTRON BOMBARDMENT ON PHYSICAL PROPERTIES OF GRAPHITE: A REVIEW OF EARLY WORK AT THE METALLURGICAL LABORATORY. M.Burton and T.J.Neubert.
J.appl. Phys., Vol. 27, No. 6, 557-67 (June, 1956).

NEUTRON-INDUCED DISCOMPOSITION OF GRAPHITE. J. appl. Phys., Vol. 27, No. 6, 568-72 (June, 1956). I. FUNDAMENTALS. M.Burton and T.J.Neubert (ibid. 568). II. PRELIMINARY STUDIES OF ELASTIC MODULUS. T.J.Neubert, R.C.Hirt and A.R.Van Dyken (ibid. 568). III. PRELIMINARY STUDIES IN ELECTRICAL RESISTIVITY. T.J.Neubert, M.G.Bowman, A.R.Van Dyken and J.Royal (ibid. 569). IV. FURTHER STUDIES OF ELASTIC MODULUS AND ELECTRICAL RESISTIVITY. M.G.Bowman, W.R.Burns, R.C.Hirt, T.J. Neubert, A.Novick, J.Royal and A.R.Van Dyken (ibid. 569). V. THERMAL CONDUCTIVITY MEASUREMENTS. A.R.Van Dyken, M.G.Bowman, T.J.Neubert and A.Novick (ibid. 570). VI. RATE OF HEALING EXPERIMENTS. T.J.Neubert and A. Novick (ibid. 570). VII. ASYMPTOTIC ANNEALING EXPERIMENTS. A.Novick, T.J.Neubert and A.R.Van Dyken (ibid. 571). VIII. INCREASE IN INTERNAL ENERGY. R.Maurer and R.Ruder (ibid. 571). IX. THE HALL EFFECT. R.Maurer and R.Ruder (ibid. 572). X. RATE OF BROMINE ABSORPTION. A.Novick and T.J.Neubert (ibid. 572).

Fast neutron bombardment of artificial graphite increases the longitudinal elastic modulus and electrical resistivity and decreases the thermal conductivity. Annealing at temperatures higher than the bombardment temperature reverses the neutron induced property changes, but complete recovery does not occur until annealing temperatures approach 2000° C. These effects are considered to be the results of the displacement of carbon atoms from normal positions in graphite crystallites to interstitial positions and the production of lattice vacancies. The displaced atoms are trapped in a variety of metastable trapping centres and, as a result, increase the internal energy of the graphite. Annealing causes interstitial atoms to move to more stable positions, thus releasing stored energy and causing recovery of other neutron-induced changes. Hall effect studies indicate that the neutron-induced disturbances (interstitial atoms and clusters of atoms, and lattice vacancies) are electron traps. Data are presented and the implications of various observations are discussed. A.

539.213

6948. V-CENTERS IN METAPHOSPHATE GLASS. S.Basu.
Naturwissenschaften, Vol. 43, No. 9, 196 (1956).

Glass containing S_2 molecules shows a blue coloration which disappears on X-ray irradiation due to the formation of sulphur anions rather than F-centres. However, V-centre absorption is produced by the X-rays as in glass without the presence of sulphur. G.F.J.Garlick

539.217

6949. THE INFLUENCE OF PRESSURE ON THE MUTUAL INTERDIFFUSION OF METALS IN RELATION TO THE PRODUCTION OF DIFFUSION POROSITY. Ya.E.Geguzin.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 5, 839-40 (1956). In Russian.

Interdiffusion between α-brass (30% Zn) and copper, wher the diffusion coefficient $D(Zn \rightarrow Cu) > D(Cu \rightarrow Zn)$, was examined experimentally at 850° C. Porosity normally arises in the brass but when a pressure of > 10 Kg/cm^2 was applied, its formation was suppressed. The greater diffusion coefficient was also reduced. Similar results were obtained for the Cu – Ni system. A.L.Mackay

539.217 : 537.543

6950. DETECTOR FOR HYDROGEN PENETRATING STEEL. J.O.McCaldin.
J. appl. Phys., Vol. 27, No. 3, 307 (March, 1956).

539.217

6951. ON INTERMETALLIC DIFFUSION IN GOLD-LEAD SYSTEM. A.Ascoli, E.Germagnoli and L.Mongini.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 123-33 (July, 1956).

This has been investigated by means of a radioactive trace method in the range of temperatures between 190 and 300° C. In this temperature interval experimental values of the diffusion coefficient D fit the equation

$$D = 2.8 \times 10^{-3} \exp\left[\frac{8.91 \times 10^3}{RT}\right] \text{cm}^2 \text{ sec}^{-1}$$

whence an activation energy $Q = (8.91 \pm 0.18) \times 10^3$ cal mole^{-1} is obtained. A.

539.217

6952. ATOMIC MOBILITY IN A Cu–Al ALLOY AFTER QUENCHING AND NEUTRON IRRADIATION. C.Y.Li and A.S.Nowick.
Phys. Rev., Vol. 103, No. 2, 294-303 (July 15, 1956).

A study of atomic mobility in a Cu–Al (17 atomic percent Al) solid solution is carried out by anelastic relaxation methods. Measurements are made under equilibrium conditions, after quenching, and after neutron irradiation. The results differ significantly in two ways from the quenching experiment of Kauffman and Koehler on pure gold. First, the ratio J/Q (where J is the activation energy for migration of the appropriate lattice defect, and Q the activation energy for equilibrium atomic diffusion) is 0.6 in the present experiments and only 0.36 for the quenched gold. This difference in ratio corresponds to a difference of about two orders of magnitude in the vacancy concentration at the melting point. Second, in contrast to the behaviour of the pure metal, the irradiated Cu–Al alloy shows no evidence for the annealing of point defects in the range of temperature in which quenching effects anneal out It is therefore difficult to reconcile the present results with those on pure gold if one assumes that the same lattice defect is responsible for both. A survey of other quenching experiments and of measurements on the annealing of cold-worked metals provides additional evidence for a defect for which $J/Q = 0.5$–0.6 in various metals. A tentative interpretation of existing data may be given in terms of the assumption that the low-mobility (high J/Q) defect is the single vacancy while the high-mobility defect is the divacancy. A.

539.219 : 539.319

6953. STRAIN-AMPLITUDE DEPENDENT INTERNAL FRICTION STUDIES OF DILUTE ALLOYS OF COPPER. S.Weinig and E.S.Machlin.
J. appl. Phys., Vol. 27, No. 7, 734-8 (July, 1956).

This paper presents an investigation of the room tempera-

re decrement in dilute polycrystalline alloys of copper as a nction of strain amplitude and annealing at a frequency of out 1 c/s. The characteristics of the internal friction measred are: (1) The internal friction and strain-amplitude ependence of the internal friction decreases with increasing olute content. (2) The internal friction is reversibly dependnt upon the preanneal temperature. (3) The internal friction s hysteretic with strain amplitude. From the effect of the olute concentration and annealing temperature on the decrement, values for the binding energy for Al and Si solute atoms dislocations in copper were calculated. These values are ompared to theoretical values calculated on the basis of train and electrical interaction energies. The experimental inding energy is in good enough agreement with the theoretical alues to conclude that the onset of a strain-amplitude dependnce of the internal friction is caused by the freeing of sufficient dislocations from their pinning solute atoms. A.

539.219.2

6954. PREFERRED ORIENTATION IN STARK RUBBER STUDIED WITH AN AUTOMATIC INTEGRATING POLE FIGURE GONIOMETER. C.J.Newton, L.Mandelkern and Roberts, D.E.
. appl. Phys., Vol. 26, No. 12, 1521-2 (Dec., 1955).

Two systems of preferential orientation were traced, with probably a common Z axis, in a rubber kept for 20 years under compression at a temperature between 0° and 14° C. The Z axis was directed along the short diagonals of traces of parallelograms visible in the rubber and corresponding to the grooves of the mill-rolls used in processing. The analogy to residual stresses in deformed metals is pointed out.

P.Cucka

539.23 : 539.27

6955. ELECTRON MICROSCOPE INVESTIGATION OF THIN LAYERS OF ANTIMONY BY THE DARK FIELD METHOD. L.G.Stoyanova.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 3, 437-9 (1956). In Russian.

Thin antimony layers (0.5 $\mu g/cm^2$) formed by evaporation were examined by electron diffraction and bright and dark field electron microscopy. The dark field image of the so called amorphous layer (as determined from diffuse diffraction rings) shows it to be finely crystalline with crystal size of 30 to 35 A. J.W.Menter

539.23

6956. INTERNATIONAL COLLOQUIUM ON THE PRESENT STATE OF KNOWLEDGE OF THE ELECTRICAL AND MAGNETIC PROPERTIES OF THIN METALLIC FILMS, IN RELATION TO THEIR STRUCTURE.
J. Phys. Radium, Vol. 17, No. 3, 169-306 (March, 1956). In French.

The colloquium was held in Algiers in April, 1955. For abstracts see Abstr. 6609-16, 6645, 6657, 6660-1, 6766, 6777-8, 6957-67.

539.23

6957. SOME MAGNETIC, ELECTRICAL AND OPTICAL PROPERTIES OF FILMS OBTAINED BY ELECTROLYSIS AND BY THERMAL EVAPORATION. R.M.Bozorth.
J. Phys. Radium, Vol. 17, No. 3, 256-62 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

Several experiments were carried out. Composites of thir layers of ferromagnetic materials, deposited by electrolysis, show an increase of the coercive force with decreasing thickness, as predicted by theory. The magnitude of the effect shows that both the crystal anisotropy and shape anisotropy contribute. Thin precipitates of some magnetic materials of high coercive force, studied by methods of measurements of the magnetic torque, are proved to be effective because of their shape anisotropy, magnetic crystal anisotropy being of secondary importance. Thin films of copper and other metals are produced by rapid evaporation (500 to 1000 A/sec) and found to have a better mechanical structure than those produced slowly with the same residual gas pressure. The mean free path calculated from the resistivity has the expected magnitude. It is shown that a thin layer of the semiconductor GaSb is a photoelectric conductor. The electronic mobility (Hall effect) is of the order of 10^{-2} of that of the bulk material. Certain techniques are reported for preparing films of zinc 400 A thick, on a free layer of cellulose acetate, the thickness of such composites being about 1000 A. A.

539.23

6958. APPLICATIONS IN ELECTRONICS OF THIN CONDUCTING METALLIC LAYERS. C.Dufour.
J. Phys. Radium, Vol. 17, No. 3, 290-6 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

Conductivity alone: Resistors of large value, 10^8 to 10^{13} ohms, for use in connection with photocells or ionization chambers; usual resistors; microwave attenuators; waveguides; wave propagation electron tubes.

Conductivity + light transmission: Theoretical connection between conductivity and transparency — control method using this connection; equipotential surface — electrostatic voltmeter — TV pick up tubes (vidicon) — electroluminescent devices; electrical heater for Dark Trace cathode ray tube (skiatron).

Conductivity + electron transmission: Whiddington law — Choice of the metal; aluminized cathode ray tube; special targets for storage tubes. A.

539.234 : 548.5

6959. THIN FILMS AND EPITAXY. L.Royer.
J. Phys. Radium, Vol. 17, No. 3, 171-5 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

First, epitaxy of a thin metallic deposit obtained under vacuum from vapour of corresponding metal is examined on various crystallized substrates. The case of orientation of a metal by another one and the case of orientation of a metal by a support constituted with the cleavage of an ionic crystal, are studied more carefully; an example of a metal oriented by an homopolar bonds crystal is given. Experiments and various hypothesis are then confronted. A.

539.234 : 539.27

6960. THE INITIAL STAGES OF THE FORMATION OF THIN METALLIC LAYERS OBTAINED BY THERMAL EVAPORATION ON A CRYSTALLINE SURFACE. M.Blackman.
J. Phys. Radium. Vol. 17, No. 3, 176-8 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

A number of metals have been evaporated on to a silver substrate with a flat (111) surface. This is carried out in the electron diffraction camera at a low rate of evaporation and the diffraction pattern is observed in the earliest stages of the formation of the deposit. Quantitative measurements of the average thickness of the deposit at different stages have been made in a particular case by using radioactive copper. A.

539.234

6961. TECHNIQUES FOR THE PRODUCTION OF THIN METALLIC FILMS BY CONDENSATION OF VAPOUR. E.C.Crittenden, Jr and R.W.Hoffman.
J. Phys. Radium, Vol. 17, No. 3, 179-83 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

Purity of the material, protection from chemical reaction with residual gas after deposition, crystal size and preferred orientation, crystal imperfections, mechanical stress, roughness and agglomeration are discussed. The transition metals are well behaved, the noble metals poor, and Zn, Cd and Hg

very difficult to deal with as regards producing smooth surfaced films down to a few atoms thick. Results for Cu and Ni are reported in some detail. A.

539.234 : 535.39

6962. STUDY OF THE STRUCTURE OF THIN LAYERS BY OPTICAL PROCEDURES. P.Rouard.
J. Phys. Radium, Vol. 17, No. 3, 184-9 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

Purely optical methods made it possible to show that evaporated thin films have a granular structure, generally present a transition layer on both support and air side, and a gradient of index. These results explain why polarimetric methods carried out to determine simultaneously optical constants and the thickness of thin films have not always given the expected results. A.

539.234 : 535.39

6963. REMARKS ON THE PROPERTIES OF INHOMOGENEOUS THIN FILMS. F.Abelès.
J. Phys. Radium, Vol. 17, No. 3, 190-3 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

I. Comparison between the results obtained by David's method and the result one gets in considering a thin homogeneous and isotropic layer, the thickness d of which is small compared with the wavelength λ of the incident light. II. Study of the optical properties of thin ($d \ll \lambda$), inhomogeneous but isotropic films. It is supposed that their complex dielectric constant is a function of one coordinate only, the direction of which is normal to the film. Examination of the oblique incidence, the electric vector being perpendicular to the plane of incidence. Some simple relations between the reflection and transmission coefficients and phase changes, are given. Discussion of the possibility of determining the characteristic parameters of a thin film. A.

539.234

6964. INFLUENCE OF STRUCTURE VARIATIONS ON CERTAIN ELECTRICAL AND OPTICAL PROPERTIES OF THIN FILMS STUDIED UNDER VACUUM. M.Perrot and J.P.David.
J. Phys. Radium, Vol. 17, No. 3, 194-200 (March, 1956). ("International colloquium on thin films" . See Abstr. 6956). In French.

An experimental study of some optical and electrical properties of thin layers with granular structure as functions of their thickness, all measurements being carried out simultaneously in vacuo. The authors have tried to connect the variations of these properties to the variations of structure of the layers by ageing or by action of the electrical field applied. An interpretation is given of the important variation of the optical constants from the value for bulk metal. A.

539.234 : 537.533.2

6965. INTERPRETATION OF THE WORK FUNCTION VALUE IN THIN METALLIC LAYERS. E.Darmois.
J. Phys. Radium, Vol. 17, No. 3, 210 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

In the formula $R = Ae^{w/kT}$, the term w is of the order of 1/100 eV. It is assumed that the grains of metal are charged; a sphere having a radius of 4 A can keep one electron whose work function is very low. A.

539.234

6966. PROPERTIES OF EVAPORATED FILMS OF TELLURIUM. T.Sakurai.
J. Phys. Radium, Vol. 17, No. 3, 274-7 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

Tellurium films deposited on a substrate kept at room temperature are composed of micro-crystals and amorphous portions; while those deposited on a hot substrate are well crystallized. Resistivity of the films is much affected by amorphous portions. From the measurements of the infrared absorption, the energy state of micro-crystal has been found to be nearly the same as that of the bulk crystal. The amorphous deposit seems to change its energy state by absorbing various kind of gas. A

539.23

6967. APPLICATION OF THIN METALLIC FILMS TO THE PREPARATION OF ELECTRICAL RESISTANCES, IN PARTICULAR ELECTRICAL RESISTANCES OF HIGH VALUES. B.Vodar.
J. Phys. Radium, Vol. 17, No. 3, 298-305 (March, 1956). ("International colloquium on thin films". See Abstr. 6956). In French.

Conditions are described under which thin metallic layer on glass may be used as good resistors. The importance of refractory and noble metal is shown. Some data are given on the properties of thin-layers resistors: temperature coefficient (which may be widely varied); voltage coefficient (almost negligible) power dissipation; stability (order of 0.1%). Some practical devices are presented for making different types of resistors by evaporation under vacuum: In order to use a thicker layer long and narrow films are employed; procedure for making layers of such a shape are given. A brief description is presented of an interrupted vacuum arc where the evaporated metal is ionized and may be concentrated by an electric field on the useful area; this arc is especially interesting for the practical evaporation of high melting metals. A

539.2

6968. CALIBRATION OF THE SPECIMEN TILT DEVICE OF THE EM-3 ELECTRON MICROSCOPE. J.A.Gard.
J. sci. Instrum., Vol. 33, No. 8, 307 (Aug., 1956).

An optical method is described for calibration of the specimen tilt device of the Metropolitan-Vickers type EM-3 electron microscope, for use in single-crystal electron diffraction. A

ELASTICITY. STRENGTH. RHEOLOGY 539.3/.8

539.319 : 539.374 : 541.2

6969. STRESS RELAXATION IN CONCENTRATED SOLUTIONS OF POLYMETHYL METHACRYLATE: MOLECULAR WEIGHT DEPENDENCE. J.M.Watkins, R.D.Spangler and E.C.McKannan.
J. appl. Phys., Vol. 27, No. 7, 685-90 (July, 1956).

The measurement of stress relaxation has revealed a relation between the spectrum of relaxation times, the weight average molecular weight, and the molecular weight distribution. The spectrum of relaxation times and the essentially identical theories developed by Rouse, Bueche and Zimm are used to calculate an average relaxation time which is directly proportional to the weight average molecular weight. It is then shown that a first approximation to the distribution of molecular weight may be calculated if one assumed that the friction factor increases with the 1.5 power of the molecular weight. This distribution for selected samples of polymethyl methacrylate is compared with the Schulz distribution in which the parameters were obtained from light scattering and osmotic pressure experiments. The ratios M_Z/M_W calculated from the theory and stress relaxation data on a rough fraction, a whole polymer, and a blend of two whole polymers are found to be 1.3, 1.7 and 1.9, respectively. A

539.319

6970. APPLICATION OF DISLOCATION THEORY TO INTERNAL FRICTION PHENOMENA AT HIGH FREQUENCIES. A.Granato and K.Lücke.
J. appl. Phys., Vol. 27, No. 7, 789-805 (July, 1956).

A detailed discussion of data obtained over the past 15 years concerning the damping of mechanical vibrations in the kilocycle and megacycle range is given. The dependence of the decrement and modulus change on the variables of frequency and strain-amplitude and many other parameters is compared with predictions of the dislocation theory developed in an earlier paper. Although general agreement is obtained, and many interesting quantitative results are found, it is not possible to say that the theory agrees everywhere since not all the necessary parameters are known well enough theoretically. A number of new experiments are suggested which may permit stronger conclusions to be made. A.

539.32

6971. ON THE TEMPERATURE VARIATION OF THE ELASTIC CONSTANTS OF QUARTZ. V.G.Zubov.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 3, 392-3 (1956). In Russian.

Measurements were made on a cubic block of quartz by studying the diffraction of light when ultrasonic waves of 8 to 10 Mc/s were set up in the crystal. The temperature range was 20 to 550° C and measurements were made parallel to both and X and the Y axis in quartz. Changes in behaviour were found at 370° C and 510 to 530° C. J.M.Hough

539.32 : 539.21

6972. EFFECTS OF NEUTRON IRRADIATION UPON THE YOUNG'S MODULUS AND INTERNAL FRICTION OF COPPER SINGLE CRYSTALS D.O.Thompson and D.K.Holmes.
J. appl. Phys., Vol. 27, No. 7, 713-23 (July, 1956).

Measurements of neutron irradiation effects upon the Young's modulus and logarithmic decrement of a set of copper single crystals of 99.999% purity have been made at room temperature. Interpretations of the results can best be given in terms of an oscillating dislocation line mechanism in which the oscillations are suppressed by the presence of interstitial atoms, vacancies, or some combination thereof. Comparisons of the results with the predictions of impurity line pinning are given. It is shown that an interpretation in this sense leads to generally accepted values for the dislocation densities and average segment lengths. A.

539.374

6973. LINEAR SUPERPOSITION IN VISCO-ELASTICITY AND THEORIES OF DELAYED EFFECTS. E.R.Love.
Austral. J. Phys., Vol. 9, No. 1, 1-12 (March, 1956).

Writers on elastic after-working or "viscoelasticity" have given a formula expressing the stress-history as an integral involving the strain-history linearly. If this is to be based directly on experiment, linear superposition is a necessary physical datum; but it is not sufficient, and examples are given to demonstrate this. Necessary and sufficient conditions are established in this paper, and expressed in physical as well as in mathematical terms; they may admit physical verification in some degree. Histories both with and without beginning are considered. A.

539.374

6974. STABILITY OF THIN-WALLED BEAMS SUBJECTED TO ELASTO-PLASTIC DEFORMATIONS. L.M.Kachanov.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 6, 803-6 (1956). In Russian.

A.R.Flint (J. Mech. Phys. Solids, Vol. 1, No. 2, 90, 1953) studied the buckling of I-beams in pure bending, basing his considerations on Shanley's stability criteria (Journal of Aeronautical Sciences, Vol. 14, No. 12, 713, 1947). The author uses these criteria and the plastic flow theory to derive stability equations for the general case of thin-walled open-section beams subjected to elasto-plastic deformations. A.Gelbtuch

539.374 : 541.64

6975. STRESS ANALYSIS IN VISCOELASTIC MATERIALS. E.H.Lee.
J. appl. Phys., Vol. 27, No. 7, 665-72 (July, 1956).

Linearly viscoelastic materials are considered. This is the simplest group of materials which exhibit the general stress-strain characteristics found in polymers and plastics. Three basic aspects are considered: measurement of material properties, determination from these of the operator equations between stress and strain or equivalent of the viscoelastic model, and use of this in the theoretical analysis of stress distributions. Quasi-static analysis, in which inertia forces are negligible, is treated quite generally. The wave problems which arise when inertia effects are included are restricted to one-dimensional space variations. A series of typical solutions of these types is discussed. A.

539.374 : 541.64

6976. STRESS RELAXATION STUDIES OF THE VISCOELASTIC PROPERTIES OF POLYMERS. A.V.Tobolsky.
J. appl. Phys., Vol. 27, No. 7, 673-85 (July, 1956).

The discussion is divided into four parts: chemical stress relaxation, stress relaxation in amorphous polymers, stress relaxation in crystalline polymers, and stress relaxation in certain natural polymers and polyelectrolytes. Mathematical description of the phenomena are presented in simple form. The relation between structure and viscoelastic properties of polymers are discussed and a rather complete over-all picture of these phenomena seems to be emerging. A.

539.4.016.2 : 548.5

6977. ISOTHERMAL MEASUREMENTS ON THE RELEASE OF ENERGY STORED IN COLD-WORKED ALUMINIUM. H.U.Åström.
Ark. Fys., Vol. 10, Paper 18, 197-211 (1955).

The release of energy from room-temperature compressed high-purity aluminium bolts has been investigated in the temperature range 70 to 250° C by isothermal calorimetric measurements. The apparatus was a Borelius type of microcalorimeter. At the lowest temperatures used, recovery was obtained in the specimens. By applying somewhat different formal equations for recovery suggested by Kuhlmann, Masing and Raffelsieper, and by Borelius, it is found that the equation of Borelius gives the best agreement with the experimental results. The energy of activation calculated from this equation is 27 000 cal/mole. At successively raised temperatures without renewed cold-work of the specimens, a second stage in the annealing process appears, which is distinctly separated in temperature from the recovery. From microscopic investigation it is found to depend on changes in the substructure of the metal which may be due to subgrain growth and polygonization. The experimentally determined energy of activation for this stage is 36 000 cal/mole. At about 350° C primary recrystallization was obtained in the specimens. The energy of activation for this stage is determined to 58 000 cal/mole. The measurements indicate that the subgrain changes must advance to a certain point before the recrystallization process starts. The influence of small amounts of impurities on the relaxation process is briefly discussed. A.

539.42

6978. THE TENSILE STRENGTH OF COAL. C.D.Pomeroy and W.T.A.Morgans.
Brit. J. appl. Phys., Vol. 7, No. 7, 243-6 (July, 1956).

Apparatus is described which has been developed for the measurement of the tensile strength of coal by bending thin strips. Measurements on four coals show that the strength depends on the type of coal and on the direction of loading relative to the bedding planes. One coal has been studied in some detail and the tensile strength is shown to decrease with increasing size of specimen. The effect is attributed to the increased probability of finding in larger specimens a weakness which imparts a low strength. It is estimated that for a

given size of specimen the tensile strength is of the order of one-tenth of the compressive strength. Further, it has been found possible to rejoin broken strips of this coal so that up to ten successive tensile tests can be performed on a single strip, thus enabling the distribution of the weaknesses to be studied. In general, there is an increment of strength between successive breakages, and after ten breaks the tensile strength is roughly double the value obtained at the first break. This method of studying distribution of strength does not appear to have been used previously, although it is likely to have applications to many other brittle materials. A.

539.42 : 542.41

6979. HIGH-TEMPERATURE VACUUM FURNACE FOR TENSILE TESTING. E.A.Smith and R.W.Guard.
Rev. sci. Instrum., Vol 27, No. 6, 386-7 (June, 1956).

A resistance furnace using a tantalum tube heater has been constructed for tensile testing wire specimens of metals that require protection from the atmosphere, at temperatures up to 1600° C. Specimens of molybdenum and tungsten have been successfully tested in the range from 1000° to 1600° C. A.

539.43

6980. ON THE FREQUENCY DEPENDENCE OF THE FATIGUE OF METALS. T.Yokobori.
J. Phys. Soc. Japan, Vol. 11, No. 6, 715-16 (June, 1956).

Discusses the discrepancy between the predicted frequency dependence (Abstr. 6557/1955) and recent experimental data (Abstr. 5468/1956) on non-ferrous metals. This discrepancy may be due to Frank–Read sources operating to relax the stress concentration at the apex of the fatigue crack or by the specimen temperature increasing with frequency.
W.Bardsley

539.434

6981. EXPERIMENTAL STUDY OF ELASTIC CREEP IN METAL WIRES. C.Sălceanu and M.Zăgănescu.
C. R. Acad. Sci. (Paris), Vol. 242, No. 19, 2285-7 (May 7, 1956). In French.

The angle of twist is observed, as a function of time, in a wire recovering freely after being held at a constant torsional deformation. The characteristic creep function (defined so as to decrease from 1 to 0) is found to be a linear function of log (time) in Ag and Ni; the creep functions for Cu and Fe are represented graphically. J.G.Oldroyd

539.434

6982. CREEP OF ALUMINUM SINGLE CRYSTALS. J.Weertman.
J. appl. Phys., Vol. 27, No. 7, 832-9 (July, 1956).

High-temperature creep measurements were made on aluminium specimens cut from one single crystal. The stress range covered was from 2.5×10^6 to 1.9×10^8 dynes/cm^2. The temperature range was from 157° to 616° C. The creep rate is proportional to $(\text{stress})^{4.6} \exp(-Q/kT)$ where Q is the activation energy of creep (36 000 cal/mole) and kT has its usual meaning. A.

539.434 : 536.48

6983. THE CREEP OF CADMIUM CRYSTALS AT LIQUID HELIUM TEMPERATURES. J.W.Glen.
Phil. Mag. (Ser. 8), Vol. 1, No. 5, 400-8 (May, 1956).

Experiments on single crystals of cadmium at temperatures between 1.2° and 4.2° K have shown that measurable transient creep occurs, and that the amount of such creep does not fall off rapidly with decreasing temperature. It is suggested that this creep is due to the quantum mechanical tunnel effect, which allows dislocations to penetrate barriers to their motion that cannot be overcome by the action of the applied stress alone. A.

539.501

6984. THEORY OF THE NON-NEWTONIAN RHEOLOGY OF RAW RUBBERS CONSISTING OF SUPERMOLECULAR RHEOLOGICAL UNITS. M.Mooney.
J. appl. Phys., Vol. 27, No. 7, 691-6 (July, 1956).

A theory is developed on the postulate that raw rubbers, when subjected to continuous shear in the non-Newtonian regi of flow, consist of microscopic rheological units which are semipermanent aggregates of many rubber molecules (M.Mooney and W.E.Wolstenholme, Abstr. 11490/1954). The theory treats these units as tacky, elastic solids, whose relative movement and slippage constitute the macroscopic flow of the rubber. The resulting theoretical flow curve diffe little from that given by H.M.Smallwood [J. appl. Phys., Vol. 8, 505 (1937)], but the interpretation of the parameters is radically different. The new theory leads to expressions for the number of temporary point attachments per unit area between two touching rheological units and for the mean life of these attachments. Agreement with experimental data is slightly better than in Smallwood. Two types of observed deviation from the theory can be interpreted as due to two plausible phenomena not included in the mathematical treatment. A

539.53 : 539.211 : 539.11

6985. THE RELATIONSHIP BETWEEN THE CHEMICAL AND MECHANICAL STABILITIES OF VERY HARD BODIES. B.F.Ormont.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 4, 687-90 (1956). In Russian.

Values are calculated and tabulated for the energies of atomization, full specific surface energies and free specific surface energies of a series of carbides and nitrides for speci fied lattice planes. A.L.Macka

539.533

6986. HARDNESS PLATEAUS AND TWINNING IN STEEL BY EXPLOSIVES WITH LINED CAVITIES. S.Singh, N.R.Krishnaswamy and A.Soundraraj.
J. appl. Phys., Vol. 27, No. 6, 617-20 (June, 1956).

Describes the changes in hardness and microstructure in annealed low-carbon steel by jets squirted from high explosives with steel-lined conical cavities. Hardness measurement and photomicrographs were taken along different radii in a plane normal to the axis of the crater in the steel. Each hardness v. distance curve exhibited a series of plateaux along which the hardness remained constant. The plateaux appear to be related to Neumann bands which are present in the steel. It appears that the impact of an element of the jet on the steel initiates a transient compressional stress wave in the body of the steel which results in the hardness plateaux and the increase in the number of twin directions with hardness. A.

539.537 : 541.13

6987. ON THE ELECTROCAPILLARY EFFECT OF THE LOWERING OF HARDNESS AND THE EXTERNAL FRICTION OF METALS. E.K.Venstrem, V.I.Likhtman and P.A.Rebinder
Dokl. Akad. Nauk SSSR, Vol. 107, No. 1, 105-7 (1956). In Russian.

Zero-charge potentials at the solid metal–electrolyte interface reported by various investigators for Zn, Pb, Cd, Au, Pt, Te and Sn are summarized. New results obtained by the pendulum sclerometer method are reported for lead in an acid solution. When the pendulum deforms and fragments the solid, the electrocapillary effect is the inverse of that obtained with a pendulum with friction-damped oscillations, such as was used in the experiments described by J.O'M.Bockris and R.Parry-Jones (Abstr. 8016/1953). A.Gelbtuch

539.62

6988. THE "PLOUGHING" CONTRIBUTION TO FRICTION. R.T.Spurr.
Brit. J. appl. Phys., Vol. 7, No. 7, 260-1 (July, 1956).

When a hard surface is slid over a softer surface part of the frictional resistance is due to the force required to plough asperities of the harder surface through the softer. It is shown how this ploughing contribution to friction can be obtained for hard steel balls and wedges sliding on soft metals. A.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.126

6989. PHENOMENA IN THE VICINITY OF DETONATION FORMATION IN A GAS. K.I.Shchelkin.
Zh. éksper. teor. Fiz., Vol. 29, No. 2 (8), 221-6 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 2, 296-300 (March, 1956).

Phenomena in the vicinity of a detonation are discussed. It is shown in particular that in accordance with the author's theory explaining how slow burning turns into a detonation, a detonation can occur in a gas both at some distance in front of the slow combustion as well as in its immediate vicinity. A.

541.127 : 539.132

6990. EFFECT OF SELF-DIFFUSION ON THE ORTHO–PARA CONVERSION IN OXYGEN-CONTAMINATED SOLID HYDROGEN. K.Motizuki and T.Nagamiya.
J. Phys. Soc. Japan, Vol. 11, No. 6, 654-6 (June, 1956).

When self-diffusion takes places rapidly in solid hydrogen contaminated with oxygen, the ortho–para conversion rate is enhanced. The ortho-concentration follows the diffusion equation including the effect of the oxygen; by finding the steady state solution of this equation and using values of the relaxation time, τ, associated with the self-diffusion, which were measured recently by Rollin and Watson, we can conclude that below 4^0 K the effect of the self-diffusion is negligible and above 8^0 K the self-diffusion is so rapid that it smoothes out the ortho-concentration around each oxygen molecule. The rate of ortho-para conversion above 8^0 K is calculated assuming a uniform ortho-concentration throughout the crystal. A.

ELECTROCHEMISTRY 541.13

541.133.08

6991. A PRECISION ELECTRODE-LESS CONDUCTANCE CELL FOR USE AT AUDIO-FREQUENCIES. S.R.Gupta and G.J.Hills.
J. sci. Instrum., Vol. 33, No. 8, 313-14 (Aug., 1956).

The design and performance of a transformer bridge for the measurement of the electrolytic conductivity of concentrated aqueous solutions is described. It operates at audio-frequencies and does not involve the use of electrodes. With moderately and highly conducting solutions the reproducibility of the measurements is better than 0.02%. A.

541.135

6992. A CONTRIBUTION TO THE STUDY OF THE MECHANISM OF ELECTROLYSIS. M.Balkanski.
Ann. Phys. (Paris), Ser. 13, Vol. 1, 546-610 (May-June, 1956). In French.

The various theories extant for the interpretation of overvoltage are reviewed, and the conclusion drawn that Audubert's theory appears to explain best the greater part of the available data. An experimental study of the overvoltage of Cu in solutions of $Cu\,SO_4$, $Cu_3(PO_4)_2 + H_3PO_4$, and copper acetate respectively, by the drop electrode method, then follows. Here the influence of temperature, nature of electrode, and concentration of electrolyte is determined, and the importance of the electrolyte in overvoltage phenomena demonstrated. The effect of added neutral electrolytes, e.g. KCl is found to produce a diminution in the overvoltage, and the addition of strongly hydrated ions is shown to cause much dehydration of the Cu ion. The influence of macromolecules, e.g. polyvinyl alcohol, is to augment the overvoltage. A viscosimetry study of solutions of copper acetate, $Cu\,SO_4$, and $Cu(NO_3)_2$ respectively, has been made to afford a comparative evaluation of the state of solvatation of the different ions in solution. To explain and systematize the data, an equation has been derived which is based on the theory of reaction velocity, viz.,

$$I_C = \epsilon a_+ \frac{kT}{h} \exp -(H + W_0 - A)/RT \,.\, \exp \alpha F(\eta + v_0)/RT$$

where I_C is the cathodic current, a_+ the activity of the ion, $H + W_0 - A$ the total variation of the free energy between initial and final states, α the part of the potential acting between the active state of the electrode, v_0 the potential between electrode and stable state, and η the viscosity. There are 39 diagrams and 56 references. H.H.Hodgson

541.135

6993. ELECTROLYTIC CURRENT FLOW BY BUBBLE MIGRATION. O.Flint.
J. Electronics, Vol. 1, No. 3, 263-75 (Nov., 1955).

Electrolysis of various ethylene glycol electrolytes shows a complex relationship between potential and current density. The departure from a rectilinear relationship, which obtains in aqueous media, is shown to be due to the migration between the electrodes of electrolytic bubbles carrying with them an atmosphere containing an excess of ions. Such variables as acid radical, water content, temperature, etc. have little significant effect on the potential current density relationship. A.

541.135.5

6994. MACHINE FOR THE PRODUCTION OF MICROELECTRODES. G.J.Winsbury.
Rev. sci. Instrum., Vol. 27, No. 7, 514-16 (July, 1956).

A description is given of a machine designed to produce microelectrodes from a standard 3 mm Pyrex glass tube. The glass tube is heated by a platinum coil and drawn into microelectrodes by a vertical two stage pull. The first pull is by gravity and the second by an electromagnet. The operation is entirely automatic. After the machine is switched on adjustable microswitches control the sequence of operation and finally switch the machine off when the microelectrodes are drawn. Two identical microelectrodes are produced per minute. The microelectrode tip diameters may be varied from 0.5 to 10 μ. The taper towards the tip may also be varied within wide limits to suit different experiments. Advantages of the machine over earlier microelectrode pullers are discussed together with a description of a rapid method of filling microelectrodes with conducting solutions. A.

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.15

6995. FORMATION OF 5.6-BENZANTHRACENE-C^{14} AND OF 5.6-BENZACRIDINE-C^{14} BY NEUTRON IRRADIATION OF 5.6-BENZACRIDINE. R.Muxart.
C.R. Acad. Sci. (Paris), Vol. 242, No. 20, 2457-8 (May 14, 1956). In French.

Irradiation of 5.6-benzacridine labelled with C^{14} with slow neutrons yields 5.6-benzanthracene and 5.6-benzacridine, containing C^{14} in the ratio of about 1 : 19. A mechanism is proposed which would predict a ratio of 1 : 17 for the yields of the two products. C.B.Allsopp

541.15

6996. EFFECT OF γ-IRRADIATION ON THE EXCHANGE BETWEEN TRI- AND HEXA-VALENT CHROMIUM IONS IN ACID SOLUTION. M.Lefort and M.Lederer.
C.R. Acad. Sci. (Paris), Vol. 242, No. 20, 2458-61 (May 14, 1956). In French.

After irradiation of a mixture of tri- and hexa-valent chromium ions, in which only the tri-valent chromium is labelled with Cr^{51}, the activity is found to have passed largely to the hexa-valent ions. Oxidation of trivalent chromium must therefore have proceeded simultaneously with reduction of hexavalent chromium in the mixture, since the net effect of the irradiation is a reduction of the hexavalent ions.
C.B.Allsopp

541.15 : 535.376

RADIATION-INDUCED LUMINESCENCE. TERTIARY AND QUATERNARY SOLUTIONS OF CYCLOHEXANE, BENZENE, p-TERPHENYL AND OXYGEN. See Abstr. 5795

DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.18.041

6997. PERIODIC PRECIPITATION. S.Prager.
J. chem. Phys., Vol. 25, No. 2, 279-83 (Aug., 1956).

The phenomenon of periodic precipitation has been subjected to calculations based on the diffusion-plus-supersaturation model first proposed by Ostwald. The mathematical difficulty caused by an infinite density of Liesegang rings at the original junction between the two solutions is avoided by the introduction of a thin "clear" zone which is supposed to be initially free of reactants. A further simplification results from assuming that one of the reactants is present in considerable excess, so that its diffusion remains essentially unaffected by the precipitation. Calculations show that the ratio between the distances from the initial boundary of two successive rings rapidly approaches a constant value, in agreement with experiment. Results have been obtained for the case where both reactants have the same diffusion coefficient. A.

541.18

6998. AGGREGATION OF SPHERICAL PARTICLES.
G.W.Hastings, D.W.Ovenall and F.W.Peaker.
Nature (London), Vol. 177, 1091-2 (June 9, 1956).

A preliminary report on experiments made for investigating the formation of pearl-string aggregates of spherical particles of polystyrene in a solution when precipitated by the addition of non-solvent to the solution. Light scattering measurements showed that in the initial stage (5%) of precipitation the dissymmetry of angular scattering resembles more the theoretical line associated with spherical particles while in the final stage (80%) the plot shows many of the characteristics of the line for rod-like particles. An electron micrograph at the 50% precipitation point is shown. R.Neumann

541.182.3 : 531.717

6999. ELECTROSTATIC PARTICLE SIZE ANALYZER.
H.H.Yoshikawa, G.A.Swartz, J.T.MacWaters and W.L.Fite.
Rev. sci. Instrum., Vol. 27, No. 6, 359-62 (June, 1956).

Comprises the theoretical analysis and physical description of an Electrostatic Particle Size Analyzer (EPSA) for determining the particle size distribution of aerosols in the 1 to 20 micron size range. Included are photographs and histograms illustrating the size separation attained and also a histogram of the particle size distribution in the general aerosol as determined by use of the instrument. A.

541.182.3

7000. ON THE QUESTION OF THE FORMATION OF CELL STRUCTURES IN LAYER MISTS OR SMOKES.
V.K.Lyapidevskiĭ.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 399-400 (1956). In Russian.

Describes experiments on alcohol mists, ammonium salt suspensions and tobacco smoke. J.M.Hough

CHEMICAL ANALYSIS 543/545

545.3

7001. COULOMETRIC TITRATIONS USING A PULSE TECHNIQUE. M.A.V.Devanathan and Q.Fernando.
J. sci. Instrum., Vol. 33, No. 8, 323 (Aug., 1956).

Constant pulses instead of steady current are used in the titrations so that measurement of the number of coulombs is made by mere counting of the number of pulses. The circuit, apparatus, and an application to the titration of 8-hydroxyquinoline with bromine are described. An accuracy of better than 1% is claimed with quantities of 100-400 μg of 8-hydroxyquinoline. W.Good

545.71

7002. A METHOD FOR RAPID ANALYSIS OF VERY SMALL GAS SAMPLES. H.E.Lewis and O.C.J.Lippold.
J. sci. Instrum., Vol. 33, No. 7, 254-6 (July, 1956).

An apparatus is described for the analysis of small samples of gas (0.1-0.001 cm^3). A small bubble of the sample is injected into water in a chamber formed by two horizontal parallel plates. This bubble assumes the shape of a disk, which can be measured, since the volume is then proportional to its cross-sectional area. Convenient methods of optical measurement and recording are described. Analysis is made by the introduction into the chamber of suitable absorbents. Reference is made to some of the uses of this apparatus. A.

545.83

7003. MICRODOSAGE OF SULPHUR BY MEANS OF THE NUCLEAR REACTIONS S^{32}_{16} (d, α) P^{30}_{15}. P.Sue and P.Albert.
C.R. Acad. Sci. (Paris), Vol. 242, No. 20, 2461-2 (May 14, 1956). In French.

K_2SO_4 fused on Pt foil was exposed to deuterons. The salt was extracted with water and carrier phosphorus was added. P^{30}_{15} was then precipitated as ammonium magnesium phosphate and estimated. The sensitivity of the method is 1 μg of sulphur to $\pm$15%, and 10 p.p.m. of sulphur in 20 mg of material. C.B.Allsopp

CRYSTALLOGRAPHY 548

548.12 : 538.112

7004. MAGNETIC SYMMETRY OF CRYSTALS. B.A.Tavger and B.M.Zaĭtsev.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 564-8 (1956). In Russian.

The symmetry of crystals with magnetic moments is considered. Besides transformations of coordinates, transformations involving a change of the sign of time are also treated. The corresponding point groups of symmetry transformations are derived. Nonsymmetry, with respect to change of sign of time, of the structure of crystals possessing magnetic moments is indicated. A.

548.2

7005. ON THE DOMAIN STRUCTURE OF ROCHELLE SALT CRYSTAL. T.Nakamura.
J. Phys. Soc. Japan, Vol. 11, No. 6, 624-32 (June, 1956).

The effect of the condition of crystallization on the domain pattern was studied by a polarization microscope. Slow crystallization at the temperatures between the two Curie points gave domains parallel to the b-axis, whereas above the upper Curie point they were parallel to the c-axis. On raising temperature through the upper Curie point, monoclinicity decreased gradually, without any change of domain width, until the domain pattern disappeared at $24.25^\circ \pm 0.2^\circ$C, where marked pyroelectricity and a maximum of permittivity were observed. The pyroelectric effect continued to exist up to a temperature a little higher. Annealing of the crystals in the atmosphere of appropriate humidity had no effect on the domain formation. This fact, together with the fact that the crystallization between the two Curie points brought about the splitting into domains seems to show that the domain formation is mainly governed by elastic energy rather than electrostatic energy. Explanations of the observed phenomena are presented. A.

548.24

7006. THE QUESTION OF THE EXISTENCE OF A TRANSITIONAL LAYER IN MECHANICALLY TWINNED CRYSTALS. G.B.Raĭs.
Dokl. Akad. Nauk SSSR, Vol. 106, No. 5, 841-4 (1956). In Russian.

Some theories of twinning suggest the existence of a transitional layer ~ 500 A thick between components of a twin. Measurements of light reflected from the twin plane in mechanically twinned crystals of calcite contradict this and indicate the change to be abrupt. A.L.Mackay

548.33

7007. DILATOMETRICAL INVESTIGATIONS OF THE POLYMORPHIC TRANSFORMATION OF POTASSIUM SULPHATE ON A SINGLE CRYSTAL. M.Bernard and J.Jaffray.
C.R. Acad. Sci. (Paris), Vol. 242, No. 21, 2512-14 (May 23, 1956). In French.

A single crystal is formed by fusion and slow cooling. A large anisotropy is found, but the volume change occurs at a temperature of 586°C both on cooling and heating. The transition from pseudo-hexagonal at low temperatures, to hexagonal at high temperatures is not continuous, which suggests a change in structure. C.Turner

548.5

7008. GROWTH SPIRALS ON CRYSTALS OF WO_3. S.Tanisaki.
J. Phys. Soc. Japan, Vol. 11, No. 6, 620-3 (June, 1956).

Growth spirals were observed on the (001) and {111} surfaces of WO_3 crystals which were prepared by sublimation. The spirals on (001) are of "circular symmetry", but the spirals on {111} are of a characteristic shape which is explained by the crystal structure. It was found that in any one region of the crystal the dislocations were not only predominantly of the same sign but also had the same strength. Movement of the dislocations has been illustrated. Besides these spirals the layer formation from edges or corners of crystals was observed. A.

548.5

7009. METAL WHISKERS. J.Franks.
Nature (London), Vol. 177, 984 (May 26, 1956).

Experimental evidence is given that whiskers grow on tin under compression when extrusion is inhibited. The behaviour of whisker sources on tin plate was studied, the structure of whiskers were examined by electron microscopy. Whiskers may grow by a mechanism involving glide of dislocations. J.Franks

548.52 : 537.32 : 536.21

7010. SINGLE CRYSTAL BISMUTH TELLURIDE. L. Ainsworth.
Proc. Phys. Soc. B, Vol. 69, Pt 6, 606-12 (June, 1956).

Bismuth telluride has been investigated because of its promise as a material for thermoelectric applications. Attempts have been made to grow single crystals of the material by the Stockbarger method, by directional freezing in a horizontal boat, and by pulling from the melt. The first two methods were not found to be satisfactory because of segregation of tellurium towards the last end of the ingot to freeze. This was particularly marked at the slow speeds of withdrawal desirable for good single crystal growth. At fast speeds of withdrawal the segregation was prevented, but at these speeds large single crystals were not produced. Larger crystals, about 1 cm x 2 cm x 3 cm were produced by the pulling method, using a hydrogen atmosphere. These were all p-type of thermoelectric power 200-215 μV deg^{-1} even when considerable departures from the stoichiometric composition Bi_2Te_3 were made in the charge from which the crystals were pulled. The energy gap of this material measured optically, was 0.15 eV. A p-type single crystal specimen of thermoelectric power 200 μV deg^{-1} had a room temperature electrical conductivity of 500 Ω^{-1}cm^{-1} parallel to the cleavage planes. The room temperature thermal conductivity of the same specimen was 0.0175 Wcm^{-1} deg^{-1} parallel to the cleavage planes, and 0.0076 Wcm^{-1} deg^{-1} perpendicular to the cleavage planes. A.

548.55

7011. SINGLE CRYSTALS OF EXCEPTIONAL PERFECTION AND UNIFORMITY BY ZONE LEVELING. D.C.Bennett and B.Sawyer.
Bell. Syst. tech. J., Vol. 35, No. 3, 637-60 (May, 1956).

The zone-levelling process has been developed into a simple and effective tool, capable of growing large single crystals having high lattice perfection and containing an essentially uniform distribution of one or more desired impurities. Experimental work with germanium is discussed, and the possibility of broad application of the principles involved is indicated. A.

ATOMIC AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

7012. RELATION BETWEEN THE VIBRATION FREQUENCIES OF A CRYSTAL AND THE SCATTERING OF SLOW NEUTRONS. G.L.Squires.
Phys. Rev., Vol. 103, No. 2, 304-12 (July 15, 1956).

Detailed calculations of the scattering of slow neutrons by crystals have so far been made on the basis of the Debye approximation for the vibration frequencies of the crystal. In the present work, a somewhat more realistic set of frequencies has been calculated for the case of aluminium. The results have been used to calculate the angular and energy distribution of neutrons coherently scattered in a one-phonon process. Comparison is made with the results given by the Debye approximation. The distribution function of the calculated frequencies has been used to obtain values for the Debye–Waller factor and for the total incoherent cross-section for incident neutrons with long wavelengths. A.

548.7

7013. THE AUGMENTED PLANE WAVE AND RELATED METHODS FOR CRYSTAL EIGENVALUE PROBLEMS. R.S.Leigh.
Proc. Phys. Soc. A, Vol. 69, Pt 5, 388-400 (May, 1956).

In the augmented plane wave method and in an earlier related method, both due to Slater, the wave-functions in a crystal are expressed in terms of spherical harmonics and radial functions around each atom and of plane waves between the atoms. Convergence in these two methods with respect to

the addition of l values near the atoms is discussed in the light of a variation principle which involves an arbitrary parameter. It is shown that this convergence is likely to be improved by calculating the matrix elements in a way slightly different from that given by Slater. This is illustrated by a simple example. A new method, of the same general kind, is suggested, which has some advantages over the other two methods. A.

548.7

7014. X-RAY STUDY OF THE LOCAL ATOMIC ARRANGEMENT IN PARTIALLY ORDERED Cu_3Au. D.R.Chipman.
J. appl. Phys., Vol. 27, No. 7, 739-46 (July, 1956).

The atomic arrangement present in Cu_3Au in a state of equilibrium partial long-range order has been investigated by measuring with X-ray techniques the short-range order existing below the critical temperature. A single crystal of Cu_3Au, cut parallel to a (100) face was quenched into water from 380°C, just below the critical temperature for ordering. Using monochromated Cu Kα radiation and a Geiger counter spectrometer, the diffuse scattering from this crystal was measured in the (h_1h_20) plane of reciprical space. From these data, short-range order parameters and a first neighbour size effect coefficient were obtained. The measurements show that there is a marked short-range order among the wrongly occupied sites below the critical temperature. It is shown that the measured short-range order parameters can be predicted by assuming that the wrongly occupied sites coalesce into tiny antiphase domains, and that these domains are one atomic plane in thickness, lie parallel to any one of the three sets of (100) planes in the crystal, and contain, on the average, about nine atoms each. A.

548.7 : 537.226.2

7015. ON INTERACTIONS AMONG IONS OF A $BaTiO_3$ CRYSTAL AND ON ITS 180° AND 90° TYPE DOMAIN BOUNDARIES. W.Kinase.
Progr. theor. Phys., Vol. 13, No. 5, 529-39 (May, 1955).

Discusses dipole interaction energy of a $BaTiO_3$ crystal in tetragonal ferroelectric type, and also the energy when the crystal is assumed to take antiferroelectric forms of checkerboard and stripe types, and another unstable form. By comparing dipole interaction energies of the above four configurations, the relative stability of the four types can be considered. A.

548.7

7016. NUCLEAR RELAXATION IN ANTIFERROMAGNETIC CRYSTALS. J.van Kranendonk and M.Bloom.
Physica, Vol. 22, No. 6, 545-60 (June, 1956).

A general theory of the spin-lattice relaxation process of nuclear spins in antiferromagnetic crystals, resulting from the magnetic dipolar interaction between the nuclear spins and the antiferromagnetic spins is developed. A detailed calculation of the relaxation time t_1 is carried out on the basis of the spin wave approximation for the antiferromagnetic spin system. At not too high temperatures the dominant relaxation processes are the Raman spin wave processes. For negligible anisotropy of the antiferromagnetic spin system, t_1 varies as $1/T^3$ at low temperature ($T \ll T_N$, where T_N is the Néel temperature), while for a finite anisotropy the temperature dependence of t_1 is much stronger. The theory is compared with the experimental results of Hardeman, Poulis and v.d.Lugt (Abstr. 3010/1956) on the protons in $CuCl_2.2H_2O$. The order of magnitude of t_1 at the lowest temperature (1.2°K) agrees with the theoretical value, but the temperature dependence is stronger than predicted. Possible sources of this strong temperature dependence are indicated. The dependence of t_1 on the orientation of the external field with respect to the crystal axes is discussed, and a phenomenological method of interpreting the angular dependence of t_1 in terms of spin wave theory is suggested. Finally the non-observability of the nuclear fluorine resonance in MnF_2 is discussed. A.

548.7 : 548.5

7017. ON THE DISLOCATION THEORY OF EVAPORATION OF CRYSTALS. N.Cabrera and M.M.Levine.
Phil. Mag. (Ser. 8), Vol. 1, No. 5, 450-8 (May. 1956).

A complete treatment is given of the steady state spiral both in growth and evaporation of crystals, taking account of the strain energy around the dislocation. It is shown that when the crystal is evaporating there is a limiting value of the undersaturation beyond which there is no steady state solution of the problem. The core of the dislocation is then unable to remain closed and a macroscopic pit appears at the termination of the screw dislocation. A.

548.7

7018. PRECIPITATION OF CALCIUM IN NATURAL CALCIUM FLUORIDE CRYSTALS. W.Bontinck and W.Dekeyser.
Physica, Vol. 22, No. 7, 595-606 (July, 1956).

Dislocation lines and planar arrangements of dislocations have been made visible by decoration respectively in white fluorite cyrstals and in purple specimens.. The white crystals were coloured by the Rexer method, the other by heating them in sodium vapour. The dislocations formed very irregular networks situated in {111} planes, the planar arrangements seen end on as lines are identified as the intersection of glide {110} or climb planes with the observation plane. A regular six fold arrangement of dislocation walls has also been found. X-ray analysis and absorption spectra measurements point out that the specks formed consist of calcium particles although sodium was used as colouring agent. A.

548.7

7019. DECORATION PATTERNS IN NATURAL ZnS CRYSTALS. W.Bontinck and W.Dekeyser.
Physica, Vol. 22, No. 7, 607-18 (July, 1956).

Excess zinc or silver has been introduced in natural transparent zinc sulphide crystals, by the Rexer method or by electrophoresis respectively, at temperatures between 500° C and 800° C. After such a treatment precipitates of the excess metal are observed in a number of nearly circular zones of variable size. Optical examination proved that they are formed by limited cleavage occuring in the early stages of the heat treatment. They are to be considered as thin, flat, lens shaped cavities with their main dimensions parallel to {110} faces. They are gradually filled in as the heat treatment proceeds, with zinc sulphide and excess metal, different stages of this growth in a same zone could be followed. The specks of excess metal are regularly distributed on lines having definite crystallographic directions, [111], [11$\bar{1}$], [001] in the central part of the growth in greater cavities. Decoration around their perimeter was similar to that in smaller areas. That dislocation lines have not been decorated is attributed to the absence of charged jogs in this type of crystal A.

548.7

7020. THE PHOTOCHEMICAL AND THERMAL FORMATION OF COLOUR CENTRES IN POTASSIUM AZIDE CRYSTALS. F.C.Tompkins and D.A.Young.
Proc. Roy. Soc. A, Vol. 236, 10-23 (July 10, 1956).

When freshly crystallized potassium azide is irradiated with ultraviolet light, colour centres are developed and the salt simultaneously decomposes with evolution of nitrogen and deposition of potassium in the lattice. The coloration has been investigated spectrophotometrically in the temperature range −196 to 300° C, and, by analogy with the colour centres present in irradiated and additively coloured potassium chloride, a detailed picture of the photochemical and thermal processes occurring has been obtained. Thus, at −196° C, F- and V-centres are formed, accompanied by the production of small F-centre aggregates at dislocations and sub-grain boundaries. The V-centres combine with some of the F-centres at −78° C and at 0° C the remaining F-centres aggregate at dislocations to form R'-centres. These latter are converted at 60° C into

laments of metallic potassium, of thickness 2 or 3 atoms, stributed in the crystal and, at 276°C, clusters or colloidal entres, which are identified with the nuclei formed in the ermal decomposition of azides, are produced. Extension the investigation to compressed pellets and evaporated lms provides confirmation of these conclusions. It is further nown experimentally that the colourability of azide crystals is arkedly affected by ageing and a mechanism for the ageing rocess is proposed.

548.7 : 539.11

7021. AN INVESTIGATION OF TRAPPING CENTRES IN NaCl.AgCl BY THE THERMO-OPTICAL BLEACHING TECHNIQUE. Ch.B.Lushchik, F.N.Zaitov, Kh.A.Myagi and K.Yu. Il'ken.
Zh. éksper. teor. Fiz., Vol. 30, No. 2, 403-4 (1956). In Russian.

The bleaching of a crystal heated at a constant rate and/or exposed to a constant flux of suitable radiation can be used to derive information regarding the energy structure of the activated trapping centres causing the original colouration. A brief theoretical treatment indicates relationships when either thermal or optical bleaching is predominant. Experimental results, with thermal bleaching predominant, on NaCl.0.3 M% AgCl and NaCl.0.001 M% AgCl crystals are analysed to give thermal ionization energies for various types of activated traps involved. A paper on predominantly optical bleaching is to follow. C.H.L.Goodman

548.7 : 539.11

7022. INVESTIGATION OF THE CAPTURE CENTRES IN CRYSTALS BY THERMAL IRRADIATION. Ch.B.Lushchik.
Zh. éksper. teor. Fiz., Vol. 30, No. 3, 488-500 (1956). In Russian.

A method of studying the capture centres in crystals, consisting of the measurement of the temperature dependence of the absorption coefficient at the maximum of the capture centre absorption bands during uniform heating of the excited crystal (method of thermal bleaching) is considered in the present paper. The theory of the method is developed for capture levels of the same depth and also for capture levels of significantly varying depths. Possibilities of the method are illustrated by the data obtained by thermal bleaching of single crystals of KCl, $KCl,CaCl_2$ and $KCl.SrCl_2$. A.

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.732

7023. ON A STUDY OF THE SUPERPOSITION EFFECT OF DIFFRACTED X-RAYS BY A LIQUID COLUMN AND THE OPTIMUM THICKNESS FOR X-RAY DIFFRACTION. A.K.Dutta and T.Ratho.
Z. Phys., Vol. 145, No. 5, 585-91 (1956).

A measure of intensity due to the superposition of diffracted X-rays from elementary regions in the line of X-ray path has been calculated on the basis of Gaussian distribution of intensity from every element. This gives the optimum thickness for maximum intensity implicitly by the relation $\mu t_0 = \alpha\varphi'(\alpha t_0)/\varphi(\alpha t_0)$, where φ is the error integral and α is a characteristic of the liquid which determines the Gaussian distribution form for the particular liquid. Good agreement between the theoretical relations and the experimental values have been observed. A.

548.733

7024. ZONE REFLECTION CAMERA FOR STUDYING CRYSTAL IMPERFECTIONS BY THE SCHULZ TECHNIQUE. C.T.Wei.
Rev. sci. Instrum., Vol. 27, No. 6, 397-9 (June, 1956).

An X-ray diffraction camera for studying imperfections in single crystals by means of the Schulz technique is described. This camera provides a convenient way for aligning the crystal and for indexing the various reflections. The latter is necessary in studying the crystallography of the imperfections. Sub-boundaries and local lattice curvature with disorientation of 1 min of arc have been detected. A.

548.733

7025. NEW X-RAY CAMERAS FOR STUDYING THE FINE STRUCTURE OF POLYCRYSTALLINE MATERIALS. S.O.Tsobkallo.
Zh. tekh. Fiz., Vol. 26, No. 1, 213-19 (1956). In Russian.

A series of X-ray powder cameras particularly suitable for determinations of grain size and strain in metals has been built. The principal innovation is the provision of a standard specimen (usually strain-free Al) which obstructs the direct beam for 10% of the exposure time and produces a standard pattern on part of the film. 10 patterns can be recorded consecutively on the same sheet of film. A.L.Mackay

548.733 : 537.542

USE OF PROPORTIONAL COUNTERS IN X-RAY DIFFRACTION. See Abstr. 5965

548.734

7026. USE OF TOTAL REFLECTION OF X-RAYS FOR THE SUPPRESSION OF RAYS OF SHORT WAVELENGTH IN A POLYCHROMATIC BEAM. M.Montel.
C.R. Acad. Sci. (Paris), Vol. 242, No. 19, 2335-7 (May 7, 1956). In French.

X-rays from a slit were reflected at a polished metal surface. It has found easy to suppress the copper $K\beta$ line without affecting the $K\alpha$ intensity. The addition of a filter to remove long wavelengths gives one a reasonably monochromatic beam. A.R.Stokes

548.734

7027. METHOD FOR OBTAINING COMPLETE QUANTITATIVE POLE FIGURES FOR FLAT SHEETS USING ONE SAMPLE AND ONE SAMPLE HOLDER. M.Schwartz.
J. appl. Phys., Vol. 26, No. 12, 1507-13 (Dec., 1955).

The general expressions for the X-ray absorption corrections in the reflection region for flat sheets in any orientation are derived. These equations contain, as special cases, the correction factors of previously reported pole figure techniques and also correction factors for a new method, permitting a rapid and accurate determination of complete quantitative pole figures of flat sheets using one sample and one sample holder. For the outer regions of the polar net a low-order Bragg reflection is used with the technique of Decker, Asp and Harker; and for the centre region a higher-order Bragg reflection from the same set of planes is used with a different set of correction factors. Pole figures, obtained by this method, for cold-rolled aluminium and magnesium are presented. A.

548.735

7028. USE OF THE SECOND MOMENT AS A CRITERION OF BREADTH OF DEBYE–SCHERRER LINES. PHYSICAL SIGNIFICANCE. M.Tournarie.
C. R. Acad. Sci. (Paris), Vol. 242, No. 17, 2161-4 (April 23, 1956). In French.

See Abstr. 5535 (1956). It is shown that the second moment gives the harmonic mean of the crystallite size. Some limitations to its use are noted. A.R.Stokes

548.735

7029. CONVERGENT-BEAM X-RAY ANALYSIS OF MOSAIC STRUCTURE IN POLYCRYSTALS. C.R.Berry.
J. appl. Phys., Vol. 27, No. 6, 636-9 (June, 1956).

A simple X-ray diffraction method was used to measure the mosiac misalignment and the number of dislocations in the grains of silver halide precipitates and of nickel foils where

the grain sizes were in the range from a few tenths of a micron to a few microns. The experimental arrangement is such that separate diffraction spots are produced by each grain and the width of a spot is determined primarily by the mosiac nature of the grain. It appears that measurements of angular misalignment can be made down to the limit imposed by the natural width of the X-ray spectrum lines. In general, either cold work or the presence of a substitutional impurity causes broadening of the diffraction spots. However, it is possible to incorporate impurities without producing broadening or dislocations. In spite of a 1% substitution of iodide impurity in silver bromide, grains were produced which appear to have no edge dislocations. A.

548.737

7030. ISOSTERISM AND MOLECULAR FOURIER TRANSFORM: CRYSTAL STRUCTURE DETERMINATION OF 2-4-DIHYDROXYBENZOIC ACID AS RELATED TO THAT OF 2-HYDROXY-4-AMINOBENZOIC ACID. G.Giacomello, A.M.Liquori and A.Ripamonti.
Nature (London), Vol. 177, 944-5 (May 19, 1956).

The structure of the first compound is obtained from a knowledge of that of the second, by means of the Fourier transform method of Hanson, Lipson and Taylor (Abstr. 7316/1953). Cell dimensions and a schematic diagram of the structure are given. A.R.Stokes

548.74

7031. THE DIRECT STUDY BY ELECTRON MICROSCOPY OF CRYSTAL LATTICES AND THEIR IMPERFECTIONS. J.W.Menter.
Proc. Roy. Soc. A, Vol. 236, 119-35 (July 10, 1956).

Thin crystals of copper and platinum phthalocyanine have been studied in the transmission electron microscope. The $(20\bar{1})$ planes of the crystal lattice have been resolved and the distance between them (12.0 ∓ 0.2 A) is in close agreement with the X-ray value of 11.94 A. Imperfections in the lattice have been directly observed. Dislocations have been photographed including both complex arrays and unit edge dislocations. Unit steps 12 A high have been observed on the edge of a crystal. In a slightly deformed crystal the deformation of the $(20\bar{1})$ planes corresponds geometrically to the deformation of the surface of the crystal as would be expected with elastic deformation. One crystal displaying a feature resembling an incipient cleavage has been observed. The fracture appears to be displaced laterally from one cleavage plane to its neighbour as it traverses the crystal. The mechanism of the formation of the image is discussed in terms of the Abbé theory of image formation in the optical microscope. The image of the planes is formed as a result of interference between the zero-order and first-order spectrum from the $(20\bar{1})$ planes. The very high resolution arises from the fact that the diffracted beam from a small crystal traverses a very narrow zone of the objective lens so that the effect of spherical aberration is not severe. Experiment has confirmed the general validity of this approach. It is suggested that this method may be extended to the study of crystals of even smaller lattice dimensions than the phthalocyanines, making possible the direct study of imperfections in a wide range of materials in relation to properties known to be affected by them such as strength, plastic flow and fracture. A.

548.74

7032. A "SURVEY" NOMOGRAM FOR ELECTRON DIFFRACTION INVESTIGATIONS. H.Jahrreiss.
Z. angew. Phys., Vol. 8, No. 7, 339-42 (1956). In German.

A nomogram is described for the interpretation of electron diffraction patterns. It relates crystal spacing, Miller indices, wavelength, electron energy, Bragg angle, radius of diffraction ring and camera constants. The question of the possibility of using a similar nomogram for X-ray diffraction is discussed. J.Thewlis

548.74 : 538.221

AN ANTIFERROMAGNETIC TRANSITION IN ZINC FERRITE: NEUTRON DIFFRACTION STUDY. See Abstr. 6012

GEOPHYSICS 55

550.36 : 535.14

7033. RADIATION WITH A FINITE REST-MASS AND THE HEAT BALANCE OF THE EARTH. L.Bass.
Nuovo Cimento (Ser. 10), Vol. 3, No. 6, 1204-12 (June, 1956).

The theory of the photon with a finite rest-mass is applied to the problem of the distribution of radioactive elements in the body of the earth. The small amount of the conduction loss of heat observed on the surface of the earth could hitherto be only explained by assuming ad hoc that the radioactive sources of heat are effectively confined to a thin surface layer of some 20 km depth. It is shown that even a uniform distribution of radioactivity throughout the earth (with the density given by the measured surface value) is compatible with the heat balance if an otherwise allowable small rest-mass of the photon is assumed. In that case the surplus energy is carried away by longitudinal photons straight from the hot core of the earth. The upper limit for the admissible rest-mass (10^{-47} g, as imposed by independent considerations) is used for the present estimate. The very small magnitude of this rest-mass is the cause of the very weak interaction between longitudinal photons and matter and thus makes possible the cooling mechanism described in the paper; it also accounts for the fact that longitudinal photons had not been detected by direct measurements. A.

550.362 : 536.2.083

7034. THE MEASUREMENT OF THE THERMAL CONDUCTIVITIES OF ROCKS BY OBSERVATIONS IN BOREHOLES. A.Beck, J.C.Jaeger and G.Newstead.
Austral. J. Phys., Vol. 9, No. 2, 286-96 (June, 1956).

The various possible methods of measuring thermal conductivity by observations in a borehole are discussed in the light of practical considerations. Three designs of measuring head are described and methods of reducing the observations are given. The possibility of obtaining results by heating a considerable length of a borehole is discussed. A.

550.382

7035. ROCK MAGNETISM IN INDIA. J.A.Clegg, E.R.Deutsch and D.H.Griffiths.
Phil. Mag. (Ser. 8), Vol. 1, No. 5, 419-31 (May, 1956).

Measurements have been made of the magnetic polarization of 450 specimens of basaltic lavas of the Deccan Trap taken from two sites about 500 miles apart. With the exception of some nearly randomly magnetized specimens, the main direction of magnetization is N. 155° E. and the dip is 53° downwards. The most plausible interpretation of this result is (a) that India has drifted north from a position about 34° south of the equator when the rocks were formed some 70 million years ago and has rotated anti-clockwise through 25°, and (b) that either the earth's field was reversed when the rocks were formed or that the rocks became magnetized in the opposite direction to the field by some physicochemical mechanism. The pole position corresponding to these results does not agree with that found by other workers for British and American rocks of the same period. This suggests that a movement of

India, relative to North America and Europe, has taken place at some time during the past 70 million years. A.

550.384 : 551.510.535 : 523.78

7036. SURVEY OF GEOMAGNETIC ECLIPSE PHENOMENA. S.Chapman.
Solar eclipses and the ionosphere (London) 221-7. See Abstr. 4116 (1956) for this and the following abstracts.

Considerations are first given to the so-called corpuscular eclipse effect. In view of recent evidence that the charged particles responsible for aurorae penetrate to the E level by means of some accelerating process near the earth, dependent on the magnetic field of the earth, a corpuscular eclipse due to neutral particles is not to be expected in the E-layer. Any (weak) corpuscular eclipse effects are likely to be confined to the high layers of the atmosphere. Secondly, the effects of an eclipse on the earth's magnetic field are considered. It is shown that, on an idealized picture of the S_q current sheet under eclipse conditions, a substantial reduction of electric conductivity in a limited part results in only a small change of field at the surface of the earth. G.M.Brown

550.384 : 523.78

7037. ON THE EFFECT ON GEOMAGNETISM OF SOLAR ECLIPSES. J.Egedal.
Solar eclipses and the ionosphere (London) 228-35 (1956).

While earlier observations of the effect on geomagnetism of solar eclipses have given more or less doubtful results, some recent observations seem to be more promising. L.A.Bauer in an early paper outlined a theory of the phenomenon, and S.Chapman in 1933 worked out a theory according to which the effect manifests itself as a diminution of the departure of the daily variation. The maximum magnetic effect occurs simultaneously with maximum obscuration, and the diminution of the departure of the daily variation is of the order given by the theory. The necessary international co-operation in this work has already been started. A.

550.384 : 523.78

7038. PRELIMINARY REPORT ON THE EFFECT OF THE SOLAR ECLIPSE OF 20 JUNE 1955 ON THE EARTH'S MAGNETIC FIELD. Y.Kato, J.Ossaka and A.Sakurai.
Solar eclipses and the ionosphere (London) 243-4 (1956).

Changes of the earth's magnetic field were observed at Ceylon, which was situated in the zone of totality of the eclipse and also is near the geomagnetic equator. In addition to the conventional recording equipment, a specially designed variometer-type magnetometer was used which recorded the changes of the magnetic field visually on paper with a sensitivity of about 1 gamma per mm record. Definite changes were observed which are attributed to eclipse effects: the horizontal intensity decreased at the time of maximum phase of the eclipse, the vertical intensity increased, and the declination deviated eastward for the first half of the eclipse and westward for the latter half. It is considered that these changes result from disturbances of the electric-current system due to a decrease of the electrical conductivity as a result of the eclipse. G.M.Brown

550.384 : 551.521.67

7039. THE INFLUENCE OF THE INNER PLANETS ON THE EARTH'S MAGNETIC FIELD. J.Houtgast.
Solar eclipses and the ionosphere (London) 302-4. See Abstr. 4116 (1956) for this and the preceding abstracts.

The international daily magnetic character figures indicate that Venus, during some days around inferior conjunctions, causes a decrease in the magnetic activity on earth. The explanation presumably lies in a dispersion of streams of solar corpuscles by the magnetic field of Venus. The fact that the influence of Venus is strongest in years of smaller solar activity is in accordance with the higher ratio of slower corpuscles against fast ones, and of X-radiation during these years. It seems interesting to go further into these problems and to find out something about the manner in which a planetary magnetic field affects the corpuscular streams from the sun in order to apply this to the theory of magnetic storms. For this purpose consideration should be given to the most effective way of getting quantitative data of the influences on magnetic activity of Venus, Mercury and the moon. A.

ATMOSPHERE. METEOROLOGY 551.5

551.510.3

7040. UPPER-AIR DENSITY AND TEMPERATURE BY THE FALLING-SPHERE METHOD. F.L.Bartman, L.W.Chaney, L.M.Jones and V.C.Liu.
J. appl. Phys., Vol. 27, No. 7, 706-12 (July, 1956).

Densities were calculated from the equation for the drag force on the falling sphere, and temperatures were then obtained by using the hydrostatic equation and the equation of state of a perfect gas. The aerodynamic background and instrumentation are described; the method of calculation and the errors are discussed. The results of four rocket flights which carried out the experiment are given. Comparison with the average of other rocket measurements indicates agreement with these results. A.

551.510.5

7041. CHEMICAL TESTS AND THE STUDY OF THE UPPER ATMOSPHERE. G.Piccardi.
Solar eclipses and the ionosphere (London) 305. See Abstr. 4116 (1956).

An inorganic test which utilizes measurements of the rate of sedimentation of colloidal solutions has been developed which appears to be extremely sensitive to external phenomena. Various correlations have been suggested between the percentage of rapid sedimentations observed and certain geophysical phenomena (magnetic character figure, height of the 96 mb level, cosmic radiation, solar activity, etc.). G.M.Brown

551.510.5 : 538.566.2/.3

7042. TURBULENT MIXING THEORY APPLIED TO RADIO SCATTERING. R.A.Silverman.
J. appl. Phys., Vol. 27, No. 7, 699-705 (July, 1956).

Obukhoff's statistical theory of turbulent mixing is proposed as a replacement for the heuristic theories of Gallet and Villars-Weisskopf, and is applied to the problem of the scattering of radio waves by refractive index fluctuations. In the case of ionospheric scattering, order-of-magnitude agreement with the observed scattered power is obtained if the refractive index fluctuations are attributed to electron density fluctuations produced by turbulent mixing in the lower edge of the E layer. In the case of tropospheric scattering, it appears that order-of-magnitude agreement with the observed scattered power can be obtained, except during the summer months, by attributing the refractive index fluctuations to temperature fluctuations. During the summer months and at low scattering heights, humidity and its fluctuations are expected to play a prominent role. Experimental and theoretical evidence is cited in favour of perennial fractional-degree temperature fluctuations in the troposphere. A comparison of the Obukhoff, Villars-Weisskopf and Booker-Gordon models is given, and it is found that the Obukhoff model predicts the most scattered power. A.

551.510.535 : 523.78

7043. A THEORETICAL STUDY OF E-LAYER BEHAVIOUR DURING A SOLAR ECLIPSE. O.E.H.Rydbeck.
Solar eclipses and the ionosphere (London) 14-20. See Abstr. 4116 (1956) and following abstracts.

Expressions are developed for the theoretical reduction in electron density N of a plane-stratified isothermal E-layer during total and partial eclipses. Consideration is given to the delay of the minimum value of N on the instant of

totality of an eclipse, and the changes in layer shape are computed for forenoon and afternoon eclipses, allowing for the variation of solar zenith angle during eclipse. G.M.Brown

551.510.535 : 523.78

7044. AN IONOSPHERIC LAYER DURING A SOLAR ECLIPSE. F.Lied.
Solar eclipses and the ionosphere (London) 21-5 (1956).

The changes in electron density and nondeviative absorption for an ionospheric layer have been calculated for the eclipse of 30 June, 1954 at Kjeller. The recombination coefficient and the collisional frequency have been taken from published results. A comparison is made between the normal approximate method of analysing eclipse observations and the more detailed treatment given here. A.

551.510.535 : 523.78

7045. SOME OBSERVATIONS ON THE INFLUENCE OF A SOLAR ECLIPSE UPON THE IONOSPHERE. P.Dominici.
Solar eclipses and the ionosphere (London) 26-32 (1956).

A general analysis to a first approximation of the effect of a solar eclipse on the ionosphere is given and applied to data obtained at Rome during the partial eclipse of 30 June, 1954, together with data from some previous eclipses. It is concluded that the rate of electron loss varies as if the process of electron removal were recombination in the E- and F1-layers and attachment in the F2-layer, the recombination and attachment coefficients decreasing with altitude. In the F2-layer the decrease of electron density is, for similar conditions, more marked in winter eclipses than in summer eclipses, and it is suggested that this may be associated with F1—F2 superposition. Secondary minima of electron density observed shortly before and after the optical eclipse may be explained in terms of coronal occultation, while minima further removed from the optical eclipse are ascribed to corpuscular eclipse effects. Definite eclipse effects in the sporadic E-layer (decrease in fEs) and the appearance of a substratification between the E- and F1-layers, are sometimes observed, and may be associated with the descent of banks of charges from the F1-layer. Attention is called to the need for common standards and methods in future eclipse work. G.M.Brown

551.510.535 : 523.78

7046. REPORT ON RECENT JAPANESE IONOSPHERIC OBSERVATIONS DURING SOLAR ECLIPSES. Y.Nakata and T.Yonezawa.
Solar eclipses and the ionosphere (London) 33-5 (1956).

Results are considered from observations made during the annular eclipse of 9 May, 1948 at Wakkanai and the partial eclipses of 12 September, 1950 and 14 February, 1953 at Tokyo and Akita. The appearance of a new stratification in the F-layer appears to be a not-unusual phenomenon, although it has often been overlooked in the past. The processes of electron dissipation in the F1- and "new F"-layers are considered. During the 1953 eclipse Es-layer ionization observed at Tokyo was found to show marked parallelism with the intensity of 200 Mc/s solar radio emission. G.M.Brown

551.510.535

7047. THE IONOSPHERE ABOVE LINDAU DURING THE SOLAR ECLIPSE ON 30 JUNE 1954. W.Becker.
Solar eclipses and the ionosphere (London) 36-9 (1956).

Due to the high transmitting power of the routine sweep frequency equipment used (50 kW), the ordinary E1 critical frequencies of the E1-layer could be determined up to the maximum of the solar eclipse in spite of sometimes very intense Es echoes. They clearly demonstrate a drop of the f^0E1 values before the optical eclipse in the E1-layer. The sporadic Es ionization and dynamical processes within the E1-layer allowed no deduction of any recombination coefficients. Stormlike phenomena within the F-layer forbade a deduction of the F1 or F2 recombination coefficients here too. G.M.Brown

551.510.535 : 523.78

7048. IONOSPHERIC OBSERVATIONS IN CANADA DURING THE SOLAR ECLIPSE OF 30 JUNE 1954. K.Davies.
Solar eclipses and the ionosphere (London) 40-53 (1956).

During the solar eclipse of 30 June 1954, height/frequency ionosphere sweeps were recorded at six Canadian stations. Three of these stations lay in the auroral zone, and so a special study has been made to ascertain the influence of a corpuscular eclipse. There is some evidence for such an effect occurring some three to four hours before the visible eclipse. At stations outside the auroral zone, normal eclipse effects were observed in the F2, F1 and E layers. Ionospheric absorption measurements on 2.0 Mc/s measured at Fort Chimo indicate a definite effect due to solar ultra-violet radiation, and there is also some evidence for a corpuscular effect some four hours before the visible eclipse. A.

551.510.535 : 523.78

7049. IONOSPHERIC MEASUREMENTS IN NORWAY DURING THE TOTAL SOLAR ECLIPSE OF 30 JUNE 1954. B.Landmark.
Solar eclipses and the ionosphere (London) 54-6 (1956).

Continuous h'f recordings and absorption measurements were made at various Norwegian stations during the total eclipse of 30 June 1954, a time of extremely low sunspot activity. It is found that no good fit is possible between experimental and theoretical results for any of the stations for the E- or F1-layers on the assumption of uniform radiation from the solar disk. A solar model in which about 70% of the ionizing agency is uniformly distributed over the disk, with about 15% limited to the western limb, 5% to the eastern limb, and about 10% spread over the central part, is found to give good agreement for the E- and F1-layers. Values obtained for the recombination coefficient α are in the range $(3.0 - 4.0) \times 10^{-8}$ for the E-layer and $(1.5 - 2.0) \times 10^{-8}$ for the F1-layer. The F2-region shows a marked solar control at a period around maximum eclipse, and may also exhibit a corpuscular eclipse effect. A value $\alpha = 3.0 \times 10^{-9}$ is obtained. The absorption results, interpreted in terms of a "Chapman" D-layer, fit better to the solar model than to a uniform sun, with a value of $\alpha N_0 = 13 \times 10^{-4}$. G.M.Brown

551.510.535 : 523.78

7050. THE SOLAR ECLIPSE OF 30 JUNE 1954: PRELIMINARY REPORT. W.Stoffregen.
Solar eclipses and the ionosphere (London) 57-64 (1956).

Ionospheric measurements at two stations in Sweden during the eclipse of 30 June, 1954 are summarized. The behaviour of the Es-layer was similar to that of the E- and F-layers during the eclipse, but some hours before the eclipse the Es ionization was high. Field-strength measurements for long and medium waves indicated a short, sharp increase near the eclipse maximum. The noise-level of atmospherics was also greater during eclipse. G.M.Brown

551.510.535 : 523.78

7051. EXPERIMENTAL IONOSPHERIC OBSERVATIONS OF THE SOLAR ECLIPSE OF 20 JUNE 1955 AT BAGUIO CITY, PHILIPPINE ISLANDS. J.J.Hennessey and J.S.Torres.
Solar eclipses and the ionosphere (London) 65-8 (1956).

Studies of parameters for all the chief ionospheric layers are given for the eclipse of 20 June, 1955 in the Philippine Islands, which reached its maximum phase (96% obscuration) near noon. Values of f_{min} showed pronounced maxima before the first contact and after the last contact. Stratification of the F-layer was observed on the control days as well as on the eclipse day, and an intermediate layer between the F1- and F2-layers formed in the second half of the eclipse. There was no certain evidence of a corpuscular eclipse. G.M.Brown

551.510.535 : 523.78

7052. TEMPERATURE-CONTROLLED VARIATIONS OF THE IONOSPHERE DURING AN ECLIPSE. O.Burkard.

olar eclipses and the ionosphere (London) 69-73 (1956).

Hitherto the changes in f_0E and f_0F1 in an eclipse have been explained by the relation $dN/dt = D \cdot q_0 \cos \chi - \alpha' N^2$, where D is the fraction of unobscured sun's disk and α' a constant. But now it is known that the diurnal variation of f_0E is approximately proportional to $\cos^{1/3} \chi$, and for f_0F1 the diurnal variation is represented by $f_0F1 \propto \cos^n \chi$, where the values of n change approximately between 0.15 and 0.28. Such a variation can be explained by the assumption that there is a linear increase of temperature with height and a recombination coefficient $\alpha' = \alpha'_0 . p^k$. T^n (p = pressure; k, n = indeterminate constants). An attempt to explain the changes in electron density at Khartoum during the eclipse of 25 February, 1952 has shown that, using the same relations, there is no necessity to assume any nonuniform distribution of the sources on the sun's disk as calculated by Minnis. It is necessary to neglect the term dN/dt, but this may be a smaller error than to calculate with a constant recombination coefficient (i.e., constant temperature). The term dN/dt can be neglected in the diurnal changes in f_0E and f_0F1. The temperature at the height of maximum electron density decreases shortly after the beginning of the eclipse, and increases rapidly after the eclipse maximum. G.M.Brown

551.510.535 : 523.78

7053. THE BEHAVIOUR OF THE E1 LAYER DURING THE SOLAR ECLIPSE OF 25 DECEMBER 1954. M.E.Szendrei and M.W.McElhinny.

Solar eclipses and the ionosphere (London) 74-80 (1956).

Two methods are attempted to explain deviations in the maximum electron density of the E1-layer observed during the eclipse from the expected effects from a solar disk of uniform intensity. Some success is met by postulating more intense regions on the solar surface and correlating these with astronomical observations. In the second method, a temperature variation with time of day is considered; while this indicates a reasonable diurnal variation on a normal day, it points to a rise in temperature during the middle part of the eclipse instead of an expected drop, and hence an explanation in terms of temperature variation must be rejected. G.M.Brown

551.510.535 : 523.78

7054. THE F2 LAYER DURING ECLIPSES OF 1952, 1954 AND 1955. C.M.Minnis.

Solar eclipses and the ionosphere (London) 81-4 (1956).

It is desirable that the electron density as a function of height in the F2-layer should, where possible, be computed, because the changes in f_0F2 alone during an eclipse can give a misleading impression of the response of the layer to the drop in incident radiation intensity. At Khartoum in 1952, f_0F2 remained almost constant for two hours during the eclipse, although there were marked changes in electron density at constant height at all levels. Assuming that these changes can be accounted for by an attachment process, values of the attachment coefficient have been derived which are similar to those obtained by Savitt at Bocayuvo. The great height of the layer at Khartoum has allowed values to be computed for heights up to 400 km. The small difference between f_0F1 and f_0F2 at Inverness and Slough in 1954 has made it difficult to deduce the shape and true height of the F2-layer. After allowing for the retardation due to the F1-layer, it is concluded that the observed fall in f_0F2 was not accompanied by an appreciable change in the height or thickness of the F2-layer. The attachment coefficient determined for the peak of the F2-layer was considerably smaller than the values obtained at Bocayuvo and Khartoum for the same height. A.

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7055. COMPARISON OF THE RESULTS OF IONOSPHERIC SOUNDINGS AT BANGUI, IBADAN, KHARTOUM AND LEOPOLDVILLE. R.P.Lejay and J.Durand.

Solar eclipses and the ionosphere (London) 85-93 (1956). In French.

Results for the F2-region are compared for the eclipse of 25 February, 1952. At Bangui and Ibadan, those stations nearest to the magnetic equator, there is clear evidence for the appearance during the latter half of the eclipse of a new F2 stratification below the 'old F2'-layer. Although less marked, an analogous phenomenon is detected at Khartoum, but at Leopoldville (magnetic dip = 33.5° S) it is absent. Rapid increase in height of the 'old F2'-layer, without change of its critical frequency, also seems to accompany the appearance of the 'new F2'-layer. Possible causes of this effect of proximity to the magnetic equator are considered. G.M.Brown

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7056. MOVEMENTS IN THE F2 LAYER OF THE IONOSPHERE DURING SOME SOLAR ECLIPSES. J.O.Thomas and A.R.Robbins.

Solar eclipses and the ionosphere (London) 94-101 (1956).

Five different sets of ionosphere soundings made during eclipses have been analysed in an attempt to see whether vertical transport of electrons plays an important part in the F2-layer during an eclipse. The assumption was made that the rates of production and loss of electrons were those tentatively suggested by Ratcliffe et al. (1955). It has been found that the five sets of observations lead to fairly similar conclusions. Vertical movements of importance seem to have occurred during the eclipses. Their possible causes are considered. A.

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7057. ABSORPTION MEASUREMENTS FOR THE ECLIPSE OF 30 JUNE 1954. K.Rawer.

Solar eclipses and the ionosphere (London) 102-5 (1956).

Results are presented of field strength and virtual height measurements made at Freiburg on frequencies of 2.9 and 1.95 Mc/s during the partial eclipse of 30 June, 1954. The different behaviours observed on the two frequencies are explained in terms of the relative contributions of deviative and non-deviative absorptions. It is found possible to isolate these two types. Some observations on 1.95 Mc/s at oblique incidence are also described. G.M.Brown

551.510.535 : 523.78

7058. ABSORPTION MEASUREMENTS DURING AN ECLIPSE. W.R.Piggott.

Solar eclipses and the ionosphere (London) 106-15 (1956).

The measurement and interpretation of the changes in intensity of radio waves reflected from the ionosphere during an eclipse present many difficulties. Some methods of overcoming these are discussed and applied to observations made at Ibadan, Nigeria, during the eclipse of 25 February, 1952. It is found that the eclipse perturbation of the absorbing region implies a distribution of ionizing radiation over the sun's disk closely similar to those found for the E- and F1-layers during the same eclipse. A.

551.510.535 : 523.78

7059. SOME OBSERVATIONS OF THE LOWER IONOSPHERE DURING THE SOLAR ECLIPSE OF 30 JUNE 1954. K.Weekes.

Solar eclipses and the ionosphere (London) 116-23 (1956).

Amplitude and phase measurements were made on long and medium waves during the eclipse of 30 June, 1954 at vertical and oblique incidence. The midpoints of the oblique trajectories corresponded in general to 75-90% obscurity. Changes in reflection height were usually observed, and considerable increases in the reflection coefficient for the larger obscurations. G.M.Brown

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7060. MEASUREMENTS ON MEDIUM AND LOW FREQUENCIES AND OF ATMOSPHERIC NOISE DURING THE SOLAR ECLIPSE OF 30 JUNE 1954. E.A.Lauter.

Solar eclipses and the ionosphere (London) 124-5 (1956).

Eclipse effects on the intensity of sky-waves received on various frequencies at distances varying from 180 to 700 km are described. The dependence of the duration of the effect

(delayed start and premature ending relative to the eclipse) on frequency and distance can be interpreted in terms of a simple D-region of double structure. Atmospheric-noise measurements on 8 to 69 kc/s indicate an increase up to the eclipse maximum (depending on frequency and distance) and a steep decrease afterwards. G.M.Brown

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7061. SOME MEASUREMENTS OF THE SIGNAL STRENGTHS OF RADIO WAVES REFLECTED FROM THE IONOSPHERE DURING THE SOLAR ECLIPSES OF 30 JUNE 1954 AND 20 JUNE 1955. R.G.Rastogi, R.M.Sheriff and N.G.Nanda.
Solar eclipses and the ionosphere (London) 137-42 (1956).

The signal strengths of radio waves from B.B.C. transmissions on 15.07 Mc/s were measured at Ahmedabad during the 1954 eclipse, with control observations on a few preceding and succeeding days. The signals, which could have been either by two-hop or three-hop reflections, showed well-marked increases in intensity during the eclipse. The increase of signal strength is considered to be due to a decrease of attenuation in the F1-layer. Similar measurements were carried out for the 1955 eclipse at Trivandrum, on the radio transmission from Colombo on 4.87 Mc/s directed skyward, and at Ahmedabad on 7.19 Mc/s. Here again the signals showed well-marked increases of strength during the eclipse. In both cases the signal intensity returned to its normal value well before the end of the eclipse. The reflections observed at Trivandrum could have been from F1, if there was an F1-layer. Near the geomagnetic equator, however, F1 is not usually observable at this hour of the day. Probably the reflection took place from F2, with decrease of attenuation mainly in F1. The reflections observed at Ahmedabad should have been from E, and the decrease of attenuation during the eclipse should have taken place below E. G.M.Brown

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7062. SOLAR SOURCES OF THE IONOSPHERIC REGIONS. C.W.Allen.
Solar eclipses and the ionosphere (London) 150-7 (1956).

The first question considered asks which parts of the sun emit those radiations that produce the ionosphere. Information comes mainly from correlations between ionospheric and solar data. For the E and F radiations there is a quiet component from the whole sun and a component associated with centres of activity. The level of emission is uncertain, but is probably the lower corona. The second question concerns the intensity and spectrum of the radiation. An attempt is made to solve this from ionospheric studies, rocket observations, and solar theory, but conclusions reached are still somewhat tentative. A.

551.510.535 : 523.78

7063. THE ORIGIN OF THE E- AND F1-LAYER IONIZING RADIATION. C.M.Minnis.
Solar eclipses and the ionosphere (London) 158-63 (1956).

The evidence obtained during earlier eclipses has tended to show that the eclipse-changes in the E- and F1-layers cannot, in general, be accounted for in terms of a uniformly bright solar disk. The data, however, did not permit any reliable conclusions to be reached regarding the identity of the emission areas. During the February, 1952 eclipse, the results obtained by the British expeditions to the Sudan and Nigeria allowed the locations and relative intensities of the radiation sources to be determined fairly accurately. The two sets of data are in good agreement and show that only two-thirds of the radiation on that occasion was emitted uniformly from the disk. The additional sources appeared to be associated with areas in which green coronal emission was known to be strong at the time. The July, 1954 eclipse occurred when solar activity was exceptionally low, but the measurements made both at Inverness and Slough show that nearly 10% of the radiation came from sources other than the uniform disk. The accurate location of this residual radiation was not possible, but the best fit with the experimental data was obtained by postulating limb-brightening near the equator and limb-darkening near th poles. A preliminary analysis of the E-layer data obtained during the June, 1955 eclipse at Singapore shows that the distribution of the sources of ionizing radiation was not uniform, b the maximum obscuration was too small to allow much information to be gained about their locations. A

551.510.535 : 523.75

7064. SUDDEN IONOSPHERIC DISTURBANCES IN RELATION TO SOLAR FLARE RADIATIONS. M.A.Ellison.
Solar eclipses and the ionosphere (London) 180-3 (1956).

A solar flare emits a burst of ultraviolet radiation which has immediate repercussions in the D- and lower E-regions. The operative wavelengths are still uncertain; but Lα (1216 A) radiation at the higher levels and X-rays (~ 5 A) at lower leve seem probable. Comparisons have been made between the dev opment curves of the S.I.D.s and of the Hα radiation of the flares which caused them. On the assumption that the ultraviolet follows the same variation with time as the Hα light, some deductions can be made about the relaxation times and the maximum ionization at various levels. A.

551.510.535

7065. FORMATION OF THE IONIZED LAYERS. D.R.Bate
Solar eclipses and the ionosphere (London) 184-8 (1956).

A short summary is given of current views regarding the processes responsible for the formation of the ionized layers. It seems probable that D is due to the photo-ionization of nitri oxide by the Ly-α line; that E is due mainly to the action of X-rays in the wavelength region centred about 40 A; and that both F1 and F2 may be due partly to the action of longer X-ra and partly to the photo-ionization of atomic oxygen by ultraviolet radiation. A.

551.510.535

7066. RECOMBINATION IN THE IONOSPHERE. D.R.Bate
Solar eclipses and the ionosphere (London) 191-7 (1956).

A survey is given of the hypothesis concerning recombination in the ionosphere: amongst the collision processes considered are radiative recombination, charge transfer, ion—atom interchange, dissociation recombination, attachment, ionic recombination, and complex ion formation. A.

551.510.535 : 523.78

7067. A CRITICAL SURVEY OF ECLIPSE INFORMATION ON RECOMBINATION DATA. K.Rawer.
Solar eclipses and the ionosphere (London) 198-203 (1956).

The more important assumptions underlying the analysis of ionospheric eclipse measurements are critically examined and proposals made for future work in this field. G.M.Brown

551.510.535 : 523.78

7068. THE EFFECTIVE RECOMBINATION COEFFICIENTS IN THE E AND F1 LAYERS. C.M.Minnis.
Solar eclipses and the ionosphere (London) 204-11 (1956).

The realization that the sun cannot always be regarded as a uniformly radiating disk has meant that it is no longer possible to deduce α from the time-difference between the electron-density minimum and the eclipse maximum. Other method may sometimes be used if conditions are appropriate. During the total eclipse at Khartoum, dN/dt could be measured up to 30 sec before second contact. Although the legitimacy of the extrapolation has been questioned, a consideration of d^2N/dt^2 shows that it is probably valid. Assuming q = 0 at second contact, the evaluation of $(dN/dt)/N^2$ gives $\alpha_E = (1.51 \pm 0.12) \times 10^{-8}$ and $\alpha_{F1} = (8.2 \pm 1) \times 10^{-9}$ cm^3 sec^{-1} at estimated true heights of 125 and 170 km respectively. For a partial eclipse, the solution of Chapman's equation for various values of α and the matching of one of the resulting N(t) curves with the experimental one is unreliable unless q(t) is similar to the geo-

metrical form. However, under certain conditions an approximate value of the component of q_o due to the uniform disk radiation can be obtained by using the observed values of dN/dt at times when N or N^2 sec χ are equal; α can then be computed, using the noon value of q_o/α. Such values are not accurate, but they provide confirmation that the very high values of α which are sometimes proposed to explain zero time-lag in minimum are unlikely to be correct. The close correlation between eclipse changes in f_oE and f_oF1 shows that the locations and relative intensities of the sources of ionizing radiation for the two layers are the same. The relation between f_oE and f_oF1 can be used to compute α'_E/α'_{F1}, which is equal to q_oF1/q_oE.
A.

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7069. THE EFFECT OF A SOLAR ECLIPSE ON THE LOWER PART OF THE IONOSPHERE AND ON THE GEOMAGNETIC FIELD. T.Nagata, T.Rikitake and Y.Nakata.
Solar eclipses and the ionosphere (London) 236-42 (1956).

The changes in the electron density of the E-layer for the solar eclipse of 9 May, 1948 have been investigated on the basis of many observations in Japan and China. The distribution of the change can be shown on a chart in which local time is conventionally taken in place of longitude, and it is evident that the electron density decreased over a large area, the boundary of which reached far beyond the area of the optical eclipse. The changes in the electrical conductivity, integrated throughout the layer, have been obtained, using the electron-density distribution determined and making suitable assumptions. The modification of the S_q current system by the presence of the non-uniformly conducting area due to the eclipse was thus determined, and the three elements of the magnetic field caused by the "additional current system" (opposite to the original current at the centre of the eclipsed area) were obtained. The geomagnetic effect of the eclipse can be obtained for different observation points by moving the distribution of the magnetic field on the earth's surface along the path of the eclipse, making due allowance for the change in the direction of the original S_q current during the eclipse. With this convention, the changes in the magnetic elements at a given station were obtained and were found to agree well with the observed changes.
G.M.Brown

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7070. THE IONOSPHERIC ECLIPSE OF 23 OCTOBER 1957. S.D.Gossner.
Solar eclipses and the ionosphere (London) 275-8 (1956).

Unusual geometric conditions, arising from the fact that the axis of umbra will pass very near the surface of the earth without actually touching it, for the eclipse of 23 October, 1957 are discussed. The axis of umbra will interest each ionospheric layer twice at every instant, and the central lines so generated are computed for various heights.
G.M.Brown

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7071. THE E LAYER OF THE IONOSPHERE.
I. PHYSICAL THEORY. D.H.Menzel;
II. STATISTICAL ANALYSIS. D.H.Menzel, J.G.Wolbach and H.Glazer.
Solar eclipses and the ionosphere (London) 279-92 (1956).

Pt I considers an extended physical theory of a stratified static ionospheric layer. The equations derived are used in Pt II, which gives a statistical analysis of combined data for the E-region for the sunspot cycle 1944-53 derived from a large number of stations. Results are compared with those obtained from a similar but more limited study by Harnischmacher.
G.M.Brown

551.510.535

7072. THE EVALUATION OF THE ELECTRON DENSITY IN THE E REGION. D.Lepechinsky.
Solar eclipses and the ionosphere (London) 293-9 (1956). In French.

From the point of view of propagation it is important to distinguish two very different regions in the ionosphere: an upper region where the collisional frequency is small and propagation is "quasi-transverse" (Q.T.), and a lower region where the collisional frequency is greater than a certain critical value and propagation is "quasi-longitudinal" (Q.L.). The limit between these two regions varies with the angle between the direction of propagation and that of the terrestrial magnetic field. Propagation is Q.T. when this angle is less than about 60°, and Q.L. when it is greater than 66°. For the latitude of France for vertical incidence the limiting Q.T.-Q.L. region is situated at about 95 km. Since the vertical incidence reflection conditions for the ordinary ray in the Q.T. and Q.L. regions are different, these considerations have an important bearing on the evaluation of the electron density in the E-layer from values of f_oE. The error involved in N using the "classical" Q.T. condition when Q.L. condition is appropriate can be 30% or more.
G.M.Brown

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7073. THE F $1\frac{1}{2}$ LAYER.
Solar eclipses and the ionosphere (London) 147-8. See Abstr. 4116 (1956).

Discussion following a series of papers concerned with ionospheric eclipse results. The chief points considered were the meaning of F $1\frac{1}{2}$ and possible associations between its occurrence during eclipses and other factors such as normal F-layer stratification, magnetic dip and epoch of solar cycle.
G.M.Brown

551.510.535 : 523.78

7074. LAYER MOVEMENTS DURING AN ECLIPSE.
Solar eclipses and the ionosphere (London) 149. See Abstr. 4116 (1956).

Discussion of the possibility of observing eclipse effects in the F2 layer outside the belt of the optical eclipse on account of additional movements produced during an eclipse (Abstr. 7056/1956). There does not appear to be any marked confirmation of such an effect.
G.M.Brown

551.510.535 : 523.78

7075. SOLAR RADIATION AND LAYER THEORY.
Solar eclipses and the ionosphere (London) 189-90. See Abstr. 4116 (1956).

Discussion following a series of papers concerned with solar radiation and the ionosphere. The importance in the E region of additional radiations from active solar regions (Abstr. 7062/1956) was questioned. It was also pointed out that deductions of the relaxation time of the ionosphere from the time lag between the occurrence of S.I.D.s and maximum Hα radiation of flares (Abstr. 7064/1956) may be misleading since this may arise in the solar atmosphere.
G.M.Brown

551.510.535

7076. RECOMBINATION IN THE IONOSPHERE.
Solar eclipses and the ionosphere (London) 215-20. See Abstr. 4116 (1956).

Discussion following a series of papers concerned with recombination in the ionosphere. Points considered in detail include: the effect of movements in the E region due to the S_q current system; meaning of "effective" recombination coefficient and high value of experimental determinations; temperature changes during an eclipse; contribution of solar corona determined from eclipse data; residual radiation at eclipse totality; and variation of recombination coefficient with time.
G.M.Brown

551.510.535 : 551.521.67 : 551.594.5

7077. PHENOMENA CAUSED BY SOLAR X-RAYS AND PROPERTIES OF THE SOLAR ELECTRIC RAY BUNDLES PRODUCING THE AURORAE. L.Vegard.
Solar eclipses and the ionosphere (London) 300-1. See Abstr. 4116 (1956) and preceding abstracts.

Brief account of the effects on the terrestrial atmosphere of solar electric ray bundles. Electron rays appear to dominate auroral production, while the proton-flux influences the spectral composition of auroral luminescence. Disturbances in the ionosphere produced by the ray bundles are considered.

G.M.Brown

551.510.535

7078. LUNAR VARIATIONS IN THE IONOSPHERE. R.A.Duncan.
Austral. J. Phys., Vol. 9, No. 1, 112-32 (March, 1956).

The global pattern of the observed lunar variations of the height and electron density of the F_2 region is briefly summarized, new analyses being presented for Canberra (f_0F_2), Brisbane ($h'F_2$), and Washington (h' and f_0F_2). It is concluded that the height variation has an amplitude of from 1 to 3 km and a phase giving maximum height at 06 lunar hours at moderate latitudes and at 09 lunar hours at the geomagnetic equator. The critical frequency variation has an amplitude of from 2 to 4%, maximum critical frequency occurring at about 09 lunar hours at moderate geomagnetic latitudes and 04 lunar hours at equatorial geomagnetic latitudes. A theory of lunar ionospheric variations is then presented. The current system which Chapman has shown could be responsible for the observed lunar geomagnetic field variations is taken as a starting point: It is considered that this current must flow at a height of about 100 km. The tidal winds needed to drive the current, the potential distribution which will be set up in the dynamo layer, and the resulting periodic vertical drifts of ionization in the higher layers are calculated. It is shown that the divergence of drift velocity is too small to account for the lunar variations in f_0F_2. These are calculated taking into account the probable height variations of recombination coefficient and ionization production rate. The conclusions thus reached are in good agreement with the observed variations in the F_2. It is concluded that the amplitude of the lunar tidal wind near the E layer is about 45 times greater than that observed on the ground. A.

551.510.535

7079. SPORADIC E AT BRISBANE. J.A.Thomas.
Austral. J. Phys., Vol. 9, No. 2, 228-46 (June, 1956).

Further data are presented in support of McNicol and Gipps's classification of two types of sporadic E at Brisbane (lat. 27.5°S.), namely, sequential type (E_{SS}) and constant-height type (E_{SC}). Information is given on the occurrence, critical and blanketing frequencies, reflection coefficients, range spreading, vertical movements, and lateral extent of E_S patches. No correlation is found with sunspot cycle, meteor occurrence, or thunderstorm activity. Scattering from a turbulent medium is not responsible for E_{SC} at Brisbane. Tidal movement is regarded as the most likely cause of both types of E_S. A method of obtaining information about D region absorption is briefly discussed. A.

551.510.535

7080. A STUDY OF "SPREAD-F" IONOSPHERIC ECHOES AT NIGHT AT BRISBANE. I. RANGE SPREADING (EXPERIMENTAL). R.W.E.McNicol, H.C.Webster and G.G.Bowman.
Austral. J. Phys., Vol. 9, No. 2, 247-71 (June, 1956).

At frequencies well below the critical frequency, satellite echoes sometimes accompany the night-time F_2 echo, sometimes clearly separated, sometimes overlapping. In an investigation of these range multiplets, in addition to routine P'f sounding records, continuous virtual range measurements at fixed frequency (at stations of various separations), and measurements of mean intensities, phase-path changes, and directions of arrival, have been carried out. From a study of the results, certain simple relationships emerge, as first approximations, between the various quantities measured, namely: virtual ranges (group paths), phase-path change, zenith angle, azimuth, intensity, and the time. A parameter, having the dimensions of velocity, appearing in these relationships, has values of which 80% lie in the range 240 ± 140 km/hr, with directions of which 80% lie in the range $290 \pm 60°$. The mean duration of a satellite is 50 min. Satellites occur more frequently in winter than in summer and show a somewhat complex diurnal variation, which is described in detail, and which tends to recur from year to year. It is associated with the general night-time changes in equivalent height of the layer. Strongly reflecting E_S shows an inverse diurnal variation. No correlation with geomagnetic disturbance indices could be found. A.

551.510.535

7081. A STUDY OF "SPREAD-F" IONOSPHERIC ECHOES AT NIGHT AT BRISBANE. II. INTERPRETATION OF RANGE SPREADING. R.W.E.McNicol and H.C.Webster.
Austral. J. Phys., Vol. 9, No. 2, 272-85 (June, 1956).

A review is given of various hypotheses which might explain the behaviour of "range multiplets", in which satellite echoes accompany the F_2 echo at frequencies well below the critical penetration frequency. It is shown that these cannot arise from stratification of the layer. Some few may be due to reflection from the F layer of waves previously scattered upwards by an E_S irregularity. The great majority, however, appear to originate in reflections from irregularities in the F layer itself. This is confirmed by the directional observations, multiple-hop echo records, correlations between separated stations, and the usual shape of the range-time curves, as described in Pt I. Evidence is presented indicating irregularities with fronts up to several hundred kilometres long, with curvatures ranging up to 10^{-2} km^{-1}. The irregularities appear to take various forms, of which the simplest are (a) an inverted trough, around 100-200 km wide, (b) a gap, of roughly the same width, with reflecting surfaces which have, at some points, curvatures up to at least 10 km^{-1}, (c) a step, with height and breadth not exceeding some 10-20 km, again with edges which are strongly curved in parts. Each irregularity probably persists for a period of the order of 1-2 hr and is usually propagated through the F region with a nearly uniform velocity of the order of 200 km/hr. The balance of the evidence indicates that this is not related to any general drift of the region. A.

551.510.535

7082. INFLUENCE OF A VARIABLE STREAM OF SOLAR POSITIVE PARTICLES ON THE WIND IN THE IONOSPHERE. V.V.Shuleĭkin and L.A.Korneva.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 1, 59-62 (1956). In Russian.

A theoretical derivation of the wind produced by charged particles from the sun due to the earth's magnetic field. A periodic variation in current density is assumed, with the period of the solar rotation. J.M.Hough

551.510.535

7083. A METHOD OF DETERMINING THE RELATIVE AMOUNTS OF D- AND E-REGION ABSORPTIONS OF MEDIUM AND SHORT RADIO WAVES. A.P.Mitra.
Indian J. Phys., Vol. 29, No. 11, 518-21 (Nov., 1955).

A new method is developed by which the relative amounts of D and E-region absorptions in any medium- and short-wave observation may be determined purely on physical basis. The method utilizes the concept of "relaxation time" in ionospheric levels and rests on the fact that the "relaxation time" at the D-region levels is appreciably different from that at the E-region levels. A.

551.510.535

7084. A NEW METHOD OF ANALYSING IONOSPHERIC MOVEMENT RECORDS. G.L.Rogers.
Nature (London), Vol. 177, 613-14 (March 31, 1956).

The method depends on diffraction microscopy, whereby any radiowave pattern which is generated by Fresnel diffraction is examined optically. An ionospheric reflection may be

egarded as a point source of coherent radiation diverging om the reflecting point, and the movement of relatively small atches of ionization will give rise to a diffraction pattern on ie ground. The method has the advantage that it allows deter- ination of the height of the moving irregularity. G.M.Brown

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RADIO-WAVE PROPAGATION IN THE IONOSPHERE. ee also under "Electromagnetic waves and oscillations". ecimal classification 539.566.3

551.510.535 : 538.566.3

085. ON THE THEORY OF NON-LINEAR EFFECTS IN THE IONOSPHERE. S.A.Zhevakin and V.M.Faĭn. Zh. éksper. teor. Fiz., Vol. 30, No. 3, 518-27 (1956). In Russian.

Non-linear effects arising in the propagation of modulated and unmodulated electromagnetic waves of arbitrary amplitude in the ionosphere have been calculated taking into account the magnetic field of the earth. A.

551.513

086. MEASUREMENTS OF COUNTER-GRADIENT HEAT FLOWS IN THE ATMOSPHERE. A.F.Bunker. Australian J. Phys., Vol. 9, No. 1, 133-43 (March, 1956).

Heat flows and temperature gradients were measured in a stable atmosphere heated by the water during a United States east coast to Bermuda aeroplane flight. The flux was computed from $c_p\overline{\rho w'T'}$, where w' and T' are the vertical velocities and temperature deviations of the individual gusts. It is found that the heat flow is directed up the gradient as predicted by Priestley (1954). The expression for the maximum heat flow to be expected derived by Priestley in terms of the standard deviation of the temperature fluctuations and the temperature gradient gives the correct order of magnitude for the observed flow. A.

551.521.14 : 551.453

7087. SPECTRAL DIFFUSE REFLECTANCE OF DESERT SURFACES. E.V.Ashburn and R.G.Weldon. J. Opt. Soc. Amer., Vol. 46, No. 8, 583-6 (Aug., 1956).

The spectral diffuse reflectance of various types of desert terrain was measured at 500 A intervals in the spectral range 4000 A to 6500 A. For all types investigated except basaltic lava, the diffuse reflectance increased with increasing wavelength of the incident radiation. In general, the diffuse reflectance at 6500 A was approximately twice that at 4000 A. The various types of surfaces showed large differences in diffuse reflectance; the values ranging from 0.03 to 0.74. Measurements made of radiance from a surface of brush and windblown sand showed that the reflection does not follow Lambert's law. A.

551.521.3 : 551.594.5

7088. THE AIRGLOW AND THE AURORAE. Edited by E.B.Armstrong and A.Dalgarno. London: The Pergamon Press (1956) viii + 420 pp. (Supplement to the Journal of Atmospheric and Terrestrial Physics).

Fifty-three papers and the introductory address given at a symposium held at Belfast in September 1955. The papers are divided into the following sections: Observations of the airglow. Observations of aurorae. Theoretical considerations on the airglow. Theoretical considerations on the aurorae. Laboratory studies. Quantal calculations. Instrumentation. (Abstracts of the papers will be published later).

551.593.12

7089. ON AMPLITUDE AND PHASE PULSATIONS OF A WAVE PROPAGATED IN A WEAKLY NON-HOMOGENEOUS ATMOSPHERE. V.I.Tatarskiĭ. Dokl. Akad. Nauk SSSR, Vol. 107, No. 2, 245-8 (1956). In Russian.

Let the refractive index be $n = 1 + n_1(r)$, where $n_1(r)$ is the deviation of the refractive index from its mean value (unity) and $|n_1| \ll 1$. A.M.Obukhov has solved this problem for an arbitrary field $n_1(r)$ (Izv. Akad. Nauk SSSR, Ser. geogr. geofiz., No. 2, 155, 1953). The author derives here an equivalent solution in a simpler form which is easier to apply to practical problems (variations of the refractive index resulting from turbulent temperature fluctuations, twinkling of stars, etc.). A.Gelbtuch

551.594 : 537.22

ON SOME ELECTRICAL PROPERTIES OF WATER AND ICE. See Abstr. 5834

551.594.14 : 539.172.4

7090. RELATIONSHIP BETWEEN AIR CONCENTRATION OF RADIOACTIVE FISSION PRODUCTS AND FALLOUT. I.H.Blifford, Jr, L.B.Lockhart, Jr and R.A.Baus. Nature (London), Vol. 177, 990-2 (May 26, 1956).

Measurements at Washington during December 1954-May 1955 ("Teapot" tests February 1955) of fission product activity were made by two methods (1) Filter collection giving a measure of activity per unit volume, and (2) standard gummed paper technique measuring rate of fall-out of radioactive particles per unit area. The ratio of these two quantities has the dimension of a velocity and was named the rate of fall; average value 2.7×10^3 ft/day on fine days and 30×10^3 ft/day on wet days. J.M.Hough

551.594.6 : 523.78

7091. THE INFLUENCE OF THE SOLAR ECLIPSE OF 30 JUNE 1954 ON LOW-FREQUENCY ATMOSPHERICS. A.Ehmert and K.Revellio. Solar eclipses and the ionosphere (London) 126-31. See Abstr. 4116 (1956).

Records of atmospherics on 13 kc/s obtained at Weissenau during the solar eclipse are compared with other European records. For small atmospherics from distant centres, the variation shows a distinct peak during the eclipse. This peak is absent for stronger atmospherics of the same frequency and also for higher frequencies from nearer discharge centres. Narrow-sector d.f. observations at Payerne and Zürich, together with meteorological information, enable the source of these atmospherics to be located near the Azov Sea and the Caucasus at distances from 2000 to 2500 km. Best transmission occurred when the sun was more than 75% obscured at both reflection points for the doubly reflected waves. G.M.Brown

551.594.6 : 523.78

7092. INFLUENCE OF THE ECLIPSE OF 30 JUNE 1954 ON THE PROPAGATION OF ATMOSPHERICS ON A FREQUENCY OF 27 kc/s. R.Bost. Solar eclipses and the ionosphere (London) 132-6. See Abstr. 4116 (1956). In French.

A brief account is given of recordings of atmospherics on several frequencies during the eclipse of 30 June, 1954. Quite pronounced enhancement was observed for the weaker atmospherics on 27 kc/s, but no eclipse effects were observed at frequencies in the ranges 4-12 kc/s. G.M.Brown

551.594.7

7093. THERMODYNAMIC METHOD OF MEASURING THE REFRACTIVE INDEX OF THE AIR. DESCRIPTION OF RADIOSONDE MD 1. P.Misme. Ann. Télécomm., Vol. 11; No. 4, 81-4 (April, 1956). In French.

A radiosonde equipment is described which gives measurements of the temperature (to 0.5°C), pressure (to 1 mb), and relative humidity (to 5%) of the atmosphere, from which data the refractive index can be determined with considerable precision. An example is given which shows the height variation of refractive index and of humidity of the air to 1400 m to be of the same general form. Such a connection would not

have been discovered by the aeroplane-borne cavity resonator method of measuring the atmospheric refractive index.

G.M.Brown

551.596.1

7094. SOUND PROPAGATION IN THE LOWER ATMOSPHERE. P.Rothwell.
J. Acoust. Soc. Amer., Vol. 28, No. 4, 656-65 (July, 1956).

An account is given of experiments carried out in the lower troposphere to compare observations of audible range and of angle of descent of sound from shell bursts at various heights up to 10 000 ft with calculations made from elaborately measured temperatures and winds. In stable conditions there is satisfactory agreement. Several cases were observed of anomalous propagation in which sound rays starting upward from the source are bent back to the earth. These showed the phenomena associated with anomalous propagation on the large scale, namely, inner and outer audibility zones, "zone of silence", and double or multiple reception of the single pulse from the source. From the experience gained in these experiments suggestions are made for (1) observation of the time interval between components of the usual double or multiple bangs from a single pulse source and (2) observation of the sound from explosions in the air as well as on the ground to obtain more information than has been obtained hitherto from sound propagation, about temperature and wind in the high atmosphere. Rocket explosions might be used for the latter purpose. A.

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578.087.9

7095. A CONSTANT-VOLUME, MEMBRANE, INTERFEROMETRIC MICRORESPIROMETER. B.M.Turner.
J. sci. Instrum., Vol. 33, No. 7, 263-4 (July, 1956).

Gas exchange in the 7-10 mμl. air film enclosed between a cover slip and the end of a capillary tube closed by a thin collodion membrane is measured by the external pressure required to restore the membrane to its constant volume position parallel to the slip. Membrane displacement is observed by two-beam reflection monochromatic interferometry. The membrane separates each chamber from a common manifold leading through a central spherical joint to a conventional Warburg manometer. Rotation about the joint brings each chamber successively under the microscope. No membrane calibration is required. The capillaries are embedded vertically in an aluminium block for temperature uniformity. Preliminary results show a sensitivity of 1-10 $\mu\mu$l. A.

578.088.5

7096. DIRECT RECORDING INSTRUMENT FOR THE STUDY OF CLOTTING PHENOMENA. W.E.Gilson and P.R.Morrison.
Rev. sci. Instrum., Vol. 27, No. 6, 402-3 (June, 1956).

An optical method without mechanical disturbance to the clotting system, by "ink-writer" recording of the response of a photomultiplier cell to the light scattered by the system. A.

TECHNIQUE. MATERIALS 62/69

669

7097. PROGRESS IN METAL PHYSICS. VOLUME 6.
Edited by B.Chalmers and R.King.
London and New York: Pergamon Press (1956) viii + 354 pp.

Abstracts of the papers will be published in later issues.
For Volume 5 see Abstr. 9871 (1954).